ELECTRICAL REVIEW

and WESTERN ELECTRICIAN with which is consolidated ELECTROCRAFT

VOL. LXVI, No. 1. CHICAGO, SATURDAY, JANUARY 2, 1915. ISSUED WEEKLY

COMPRISING

ELECTRICAL REVIEW WESTERN ELECTRICIAN ELECTROCRAFT

ELECTRICAL REVIEW PUBLISHING COMPANY, INC.
608 SOUTH DEARBORN STREET
CHICAGO

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One Year, United States $3.00
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One Year, Foreign Countries 6.00
Single Copy, 10 cents. Back one month, each.. .25

Entered as second-class matter, November 7, 1908, at the Post Office at Chicago, Ill., under the Act of March 3, 1879.

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CENTRAL-STATION PROGRESS IN 1914.

In a year when business in general underwent a most serious period of depression, when retrenchments supplanted the customary extensions and advances, and economy became the slogan of the day, singularly enough the central-station industry made gratifying gains.

The optimistic predictions advanced early in 1914 were, of course, not all realized, but when viewing the industry from the dollars-and-cents aspect the returns for the year just closed will show, perhaps not the usual gains, but an increase of at least 15 per cent in gross earnings.

Obviously there is but one conclusion, the modern central station is getting closer and closer to the human needs of the times. The scattered few who still insist that electric service is a luxury need only to refer to the returns of 1914 and compare electricity with other commodities, and with the years gone by. Yet it is said that the central station is only part way to its goal of universal service.

Extension of plants, transmission lines and distributing systems during 1914 will undoubtedly fall considerably short of the previous year, for here the depression in business and financial conditions was most keenly felt. Operating and office forces were somewhat reduced and greater economy in all departments practiced by some companies.

The gains made, however, must be attributed mainly to a more intensive cultivation of business and secondarily to natural growth. The wide-awake central-station manager quickly realized that the time when arguments of economy of electric drive were most impressive was when potential motor users must necessarily effect economies in their own organizations. Power salesmen made greater effort to secure the business of the manufacturer, who previously had considered the question of saving in power costs an insignificant item. Other manufacturers were convinced that the time to make improvements was when business was light and not wait until a rush of orders made any change inconvenient. Other companies reported increased business on the basis of financing a customer's motor installation. In the lighting field proper store, show-window and sign lighting was shown to stimulate business and justify the necessary expenditure.

Residence lighting is now installed as a matter of course in new buildings and the comprehensive campaigns for already-built houses conducted by many companies resulted in the acquisition of considerable

new business, particularly in localities where the monthly-payment plan was adopted. Despite the gains made, however, the saturation point, at least in the Eastern cities, is still considerably in the distance and great consideration is being given the small-residence customer, previously neglected.

This question was brought forcibly to the attention of the industry in the form of a report presented by Mr. S. E. Doane at the annual convention of the National Electric Light Association, in which he analyzed conditions abroad and showed the small customer to be a valuable adjunct to the usual classes of consumers. The question of cheaper wiring at once arose and, while nothing definite has as yet resulted, there is every indication of the ultimate adoption of rules which will permit cheaper methods of wiring to be used under certain conditions.

Unfortunately, at a time when capital was most needed by the public utilities, the agitation for municipal ownership in many parts of the country was most insistant. This is, in a measure, probably due to the prevailing business conditions causing a feeling of unrest among the laboring classes, but it must be admitted that in many localities the trouble can be traced to the central station. Undue retrenchments which curtail needed extensions, which impair the service in any manner or which in any way cause a rupture in the harmonious relations between public and company will usually lead to a movement for public ownership, regardless of the degree of harmony that previously existed. In one city a serious situation developed because the central-station company was unable to furnish service in a reasonable time to a group of applicants, because of having reduced its working force in order to economize. In Toledo, O., and Dayton, O., the reason for municipal ownership agitation is difficult to conceive, for no other two utilities in the country are more ably managed or have striven harder to furnish service, with all that the word implies.

Closely allied with the question of public ownership is that of commission regulation, which has been extended during the year. Public-service regulation is a recognition by the state of the essentially monopolistic character of these enterprises and it is unfortunate that in more states municipal competition is not prevented. Efficient public-service regulation will make possible further reductions in the cost of production of public-utility services. It has been said that in the production of electrical energy the greatest item of expense is not the cost of labor nor the cost of coal, but the cost of money. If the element of risk could be eliminated by commission regulation and the capital charges reduced to a pure interest basis, it is evident that the cost of production would be greatly reduced. Risk cannot be abolished, but by effective safeguards and a well considered policy of public control, it can be greatly reduced.

During the past year a distinctive feature that characterized public-utility regulation was the requirement of uniform accounting. Uniform accounting constitutes the greatest advance toward a scientific and efficient system of public-service control. The control of security issues is also a step in the right direction. There is also apparent more uniformity in rate schedules and greater standardization in making valuations.

No small amount of time and money was expended the past year in the interest of safety. The slogan, "Safety First," is now universal and has unquestionably resulted in an appreciable reduction in the number of accidents. It is estimated that 85 per cent of the accidents are preventable, and the aim of the central-station industry has been to educate the employees and the public in the interest of safety. The activities of the utilities in this connection were indicated by the numerous exhibits at the recent International Exposition of Safety and Sanitation in New York. That a central-station company was awarded the highest honor during the year for its work in accident prevention is a gratifying sign of the times, particularly when it is realized that companies representing practically every industry contested.

Mention must also be made of the gratifying extension of welfare work on the part of utility companies. Savings funds, pensions, sick and death benefits, etc., are now considered as much a part of central-station work as manufacturing electricity and the industry as a whole is benefiting. The tendency in this direction is further emphasized by the establishment during the year of more employees' club rooms, libraries, etc.

WINTER USE OF ELECTRIC FANS.

The electric fan is usually looked upon as an article to be set up in the spring or early summer, utilized during the hot season of the year, and covered up and stored away when cold weather approaches. It is commonly regarded as a hot-weather help, and it is indeed that. But its usefulness is not confined to its efficacy in reducing the rigors of excessive heat, and the possessor of this comfort-bringing device who utilizes it during less than half of the year is depriving himself of 50 per cent of the returns upon his investment.

Let us consider the possibilities of the fan. It is primarily an apparatus for setting the air in motion. Since moving air furnishes the greatest relief to the overheated individual, the fan has naturally been associated with relief from hot weather. However, this is but one useful application of a moving stream of air. For ventilating purposes motion of the air is also recognized as vital, and the fan is commonly associated with this purpose. Ventilation is usually given more attention in hot weather; it is, however, quite as important in cold weather. Though perhaps not so necessary to comfort, it is just as vital to health.

Air circulation is necessary for the proper heating of many rooms in winter as well as for cooling them in summer. A common fault in heating systems is the lack of necessary radiating surface, so-called, in the apartments to be heated. While radiation plays a part,

of course, in the transfer of heat from the heating fluid to the colder enclosure, the principal mechanism for this transfer is afforded by the convection currents of air. These are set in motion automatically by the process of heating. They can be greatly augmented, however, by the skillful use of a fan; and many a room could be made comfortable by this means which remains chilly during zero spells of weather while a vain attempt is made to force higher the temperature of the radiator.

Wind conditions will frequently interfere with the furnace draft in many homes, and this usually occurs during periods of severe weather. The effect of wind may sometimes be counteracted by using an ordinary electric fan to produce a forced draft. Directing a stream of air into the ash pit will assist in maintaining a hot fire.

Interference with the display of goods in show windows is frequently caused by frost on the windows. When special displays have been arranged this is exceedingly irritating. It can usually be obviated by the simple expedient of directing a stream of air from a fan upon the pane of glass in question. Frost results from the precipitation of moisture out of the air which is chilled by coming in contact with the cold glass. If the air circulates rapidly the inner surface of the glass is kept too warm to produce this effect; or if frost has already formed it can be evaporated and removed by a current of warm air. This use of the fan would be welcomed by many a merchant if his attention were called to the possibilities of the case. Moreover he can at the same time utilize the air current for producing visible motion of some article in the window. This always tends to compel the attention of the passer-by and adds greatly to the attractiveness of any display.

Many other applications of the fan will suggest themselves to the solicitor who gives his attention to this subject, and the winter use of fans made more nearly the rule rather than the exception.

LIGHTING SERVICE ON DARK MORNINGS.

Few modern conveniences take the gloom off early rising these dark mornings as effectively as does the tungsten lamp, and yet there are thousands of households buying electricity at 10 cents per kilowatt-hour who do not realize how little it costs to employ central-station service even lavishly for the comparatively short period intervening between the moment in which resolution triumps over the relaxation of the night and the end of breakfast. Here is some excellent material for advertisers of electric service. The increasing use of electricity, even in housholds of modest circumstances, in small suburban cottages and even in frame bungalows, justifies considering the arithmetic of dark-morning lighting service with the object of adding to the central-station load at an off-peak time.

A little work with pencil and pad yields suggestive figures. Beginning with the sleeping room, suppose a 40-watt lamp is substituted for the 25-watt size often employed in a central fixture and is lighted for a half-hour during the dressing period. The operating cost is 0.2 cent per day—less than 1.5 cents a week. The increase over the cost of the 25-watt lamp for this service is about two cents per month, and the enhanced cheerfulness of the more liberal lighting can be seen in a two-minute trial of each lamp. Ample light in pantry and kitchen expedites the preparation of breakfast. Assuming that a 40-watt lamp is used in the former for 30 minutes each morning, the cost is only 1.4 cents per week. In some pantry outlets a 10-watt lamp is provided on the theory that a long-continued service can be utilized here, but there is little comparison between the quality of illumination provided by such a lamp and that furnished by the 40-watt size. Wherever the latter can be used intermittently, or at least on short runs, the increased cost of the larger unit is scarcely to be weighed against the superior service gained. About 5 cents a month measures the difference between straining the eyes of the cook and a comfortable use of the pantry, which means increased speed of production at one of the most important hours of the day. In the kitchen a 60-watt lamp operated 45 minutes each morning costs about three cents a week. Unless a kitchen is exceedingly small the use of lamps under 60 watts in size is likely to give an illumination of much less general satisfaction than can be obtained with the larger unit, although good results are often obtained with 40-watt lamps where only one or two are used per room. In homes of the apartment type, small rooms are the rule, and yet the difference between a 40-watt and a 60-watt lamp in the work of the kitchen is worth trying out.

In the nursery, two 40-watt lamps used 30 minutes each morning on the 10-cent rate cost less than three cents a week; the use of a 60-watt lamp in the dome over the dining-room table for a half hour daily costs about two cents a week; the use of two 40-watt lamps on either side of the shaving mirror for ten minutes daily costs only four cents a month, and if there is any place in the home where adequate lighting is justified it is certainly here. Other applications will readily occur to the lighting solicitor. The main point is that a few cents more a month measure the difference between a splendid service and one in which convenience is sacrificed to what is often an unnecessarily close economy in the use of electricity. These dark mornings last only a few months, but while they are with us, the cost of making them more cheerful and of "starting the day right" is well worth the few cents which it costs.

Not every home can have the open fireplace, and the wired house often lacks this enjoyable but luxurious feature of domestic enjoyment, but the great majority of users of electricity can afford all the light they want between 6 and 7:30 a. m. from November to March, and the aggregate of such business is well worth seeking.

Agreement Reached in Important Utilities Consolidation.

The officers of the Utah Light and Traction Company and the City Commission have reached an agreement with reference to the matter of consolidating the franchises of the Utah Light and Railway Company and the Merchants Light and Power Company, both of which have been acquired by the Utah Light and Traction Company. This agreement has been reached after more than two months of difficult negotiations between the parties and both sides have expressed themselves as being well satisfied with the results secured. In consideration of the transfer of these franchise rights to the new company substantial reductions in rates are made to the citizens of Salt Lake City amounting to as much as 20 per cent in the case of certain customers, the minimum reduction being 10 per cent and the average about 12 per cent. Under the ordinance as passed by the city commissioners on December 21, the company agrees to furnish the standard four-ampere luminous arc lamp at a price not to exceed $4.75 per lamp per month when fed from underground circuit and $4.50 per lamp per month when fed from overhead lines.

Standard multiple arc lamps for commercial purposes are to be furnished at a rate not to exceed $8 per lamp per month for all-night service, $5 per lamp per month for midnight service and $4 per lamp per month for 10 o'clock service. The base-rate for incandescent lighting service by meter is reduced from 10 cents per kilowatt-hour to nine cents per kilowatt-hour and a minimum charge of $1 per month is provided, also a discount of 10 per cent if bills are paid within seven days from date. The company agrees to furnish the city with 25 standard arc lamps free, and also to furnish free electrical energy for lighting purposes up to any amount not exceeding 400,000 kilowatt-hours per annum. The furnishing of this free light, however, is conditioned upon the company receiving and having the contract to furnish the municipal street lighting. The company further agrees to furnish the city with 62.5 horsepower of electrical energy free for power purposes and to furnish such additional power which the city may require for pumping and other municipal purposes up to 125 horsepower at a price not to exceed one cent per kilowatt-hour for service 24 hours a day, provided that none of the power purchased or obtained is used for lighting purposes. The company further agrees to issue commutation tickets of 50 fares for $2 and to grant the same transfer privileges on the commutation tickets as on the regular fares. Also to issue students tickets at the rate of 50 fares for $1.50 with the same transfer privileges. From January 1, 1915, to August 24, 1937, the company must pay an income tax at the rate of one-fourth of 1 per cent upon the gross revenues of the company derived from the sale of electrical energy for lighting purposes. For the remaining period of the franchise the tax is increased to one-half of one per cent upon the gross revenues from electric lighting. It is provided that if the volume of the company's business shall so increase as to materially reduce the cost of producing or distributing electrical energy, the city and the company shall appoint an arbitration committee who shall have full authority to go over the books of the company and determine what rates shall be reasonable to charge and the company agrees to thereafter put such rate in effect, provided, however, that if the state should create a public utilities commission for this purpose then the provision for an adjustment of the rates by the city shall become void.

It is estimated that the concessions granted the city in the way of lighting and power service is worth approximately $27,000 per year and that the saving to private consumers as a result of the reduced rate will amount to more than $100,000 per year. The gross income tax as provided will amount at the outset to about $1,600 per year and will increase with the city's growth and will be doubled in 1937 when the higher rate obtains.

Valuation of Detroit Railways.

E W. Bemis, who was employed by the city of Detroit to make a physical valuation of property owned by the Detroit United Railways Company within the city limits or the one-fare zone, has completed his report and fixed the valuation, exclusive of franchise values and paving, at $16,000,000. Franchise values and paving valuations may bring the total valuation up to $20,000,000.

This valuation includes 222 miles of track or about one-fourth of the entire mileage of Detroit United Railways. In the complete inventory submitted by the company to the city the value of property within the one-fare zone was placed at $32,000,000. The appraisal made by the committee of fifty for the city in 1909 placed the value within the one-fare zone at $11,293,479.

Detroit United Railways Company, in order to prepare for permanent financing of the company, is having an appraisal of all property, including interurban lines, made by the Michigan State Railroad Commission under direction of Prof. M. E. Cooley. Until this work is completed and the figures found by the Commission are available, the company will not enter into any negotiations with the city in regard to a price at which the city lines will be sold to the municipality.

In case the city and company cannot agree on a price for the city lines the courts will be appealed to and if the courts cannot fix a price satisfactory to both parties then the city will attempt to condemn the lines.

Busy Season for Minnesota Jovians.

Last week was one of the busiest weeks the St. Paul Jovian League experienced for a long time. On Monday evening, December 21, 65 members of the league assembled at the lunch rooms of the Tri-State Telephone Company for an electric Christmas smoker and Dutch lunch. A. L. Frankenberger, of the Western Electric Company, appeared in the guise of Santa Claus and auctioned off Chrismas presents in the shape of sample electric devices. W. S. Williams, of the Tri-State Telephone Company, spoke on "Made in St. Paul," and urged the individual members to boost for local products. Clovis M. Converse, tribune of the St. Paul League, presided. The meeting was one of the best get-together meetings the league has held this season. A series of meetings on a similar plan will be held during the winter.

On December 24 a number of the Jovians, headed by Mr. Converse, helped 6,000 children of St. Paul to a memorable Christmas event when they decorated two large municipal Chrismas trees. The trees were provided by the St. Paul Association of Commerce. One of them was set up in the auditorium, the other in a park nearby. The Jovians decorated both with a large number of bulbs whose colored brilliancy will long be remembered by the children present at the exercises.

Plans are under way for a co-operative rejuvenation meeting by the St. Paul and Minneapolis Jovian Leagues, to be held in St. Paul in January.

Chicago Jovian League.

Charles A. Munroe, vice-president of the Public Service Company of Northern Illinois, spoke on the subject of "Salesmanship" at the meeting of the Chicago Jovian League on December 28. He said that all of us, regardless of our particular field of endeavor, were salesman, in the broad sense, and as such should be as cognizant of the general attributes of a salesman as those actually engaged in a sales capacity. The principal qualifications are knowledge, health, self-control, honesty and enthusiasm.

The Year in the Electrical Industry.

Without exception the task of collecting information with regard to the developments in the industry during the past year and the securing of a definite opinion as to current events is more difficult at this time than ever before. The end of 1913 broke badly in a way for the electrical industry. It will be remembered that the first half of 1913 bid fair to make that year a banner one in the electrical industry. The latter half of 1913, however, did not come up to the promise that the first half indicated. Similarly the first six months of 1914 seemed to indicate a building-up period, and an impending removal of long-disturbing legislative and economic causes for unrest and apprehension made everyone feel that the latter half of 1914 would witness the development of an increased material prosperity. The breaking out of European hostilities on August 1 completely upset all expectations and the close of the year leaves us still in a state of suspense. Notwithstanding the disturbed condition of affairs, however, progress of an orderly sort has been made in both the technical and commercial departments of the electrical industry. The review of the advances made in the great divisions of the art and application of electricity that is presented on the following pages has been contributed to by the leaders in these various departments. Acknowledgment is hereby gratefully tendered to those who have assisted in the compilation of these data, among whom may be mentioned Charles Blizard, John J. Carty, C. J. Fechheimer, Charles Fortescue, Stephen Q. Hayes, R. E. Hellmund, Carl Hering, Peter Cooper Hewitt, William B. Jackson, B. G. Lamme, W. S. Moody, E. J. Nally, F. W. Peek, Jr., R. F. Schuchardt, Arthur Simon, H. F. Stratton.

Telephone and Telegraph.

In telephony and telegraphy there has been but little change. Selective systems have been improved, and there has been introduced in telephone train dispatching, which has had a considerably increased vogue, the use of a loud-speaking receiver, which eliminates the necessity of the operator wearing continuously the headgear necessary heretofore. The loud-speaker also relieves the operator of the annoying static noises which often accompanied the use of the contact receiver, and this innovation has proved to be a great boon for work of this character. During the year what is apparently a successful adaptation has been an innovation in the form of an interlocking device between the hook-switch and the generator for eliminating interference in multi-party lines through listening in by non-wanted stations. Early in the year Postmaster-General Burleson submitted to the Senate a report prepared by a committee of officials of the Post-office Department recommending government monopoly of telephone, telegraph and radio-communication. Well informed students of the subject were free in their criticism of this report, and condemned it for its lack of absolute information with regard to the question at issue.

Previous references have been made to the progress of the American Telephone and Telegraph Company and its associated companies in connection with the constructing of a through underground route and the placing therein of an underground cable extending from Boston to Washington, a distance of about 450 miles. The completion of the work on this large undertaking, representing underground telephone cable construction about four times as long as any other such construction in the world, was reported during 1913. During the present year arrangements have been made so that it has been possible to carry on a through underground talk over this distance, almost 500 miles, cable being employed for the whole distance. Many of the circuits in this cable are now in commercial service, and all are available at any time when by reason of storms or for other causes there is interference with the open wire operation.

During the very severe and destructive storm of about March 1, 1914, this cable, at a time when practically all overhead wires through a large section of the East were seriously damaged, was signally successful in maintaining telephone service. By means of the cable all points along its route from Boston to Washington were connected with each other. In addition such open wire routes to other parts of the country as were available at any point throughout the length of the cable were by means of the cable circuits made useful for all of the places to which the cable extended. During another storm, occurring early in December of this year, the cable performed a similar service most successfully.

During the first part of 1914 there was placed in service a new long-distance toll board at New York City, to take the place of a board which was becoming outgrown, and therefore reaching the point where it was no longer adequate to the constantly increasing demands upon it for telephone service. To accommodate this switchboard and the apparatus and forces, which could best be located in the same building with it, a fireproof structure was erected near the telephonic center of the city especially designed and adapted to the equipment to be placed in it. This building is 18 stories in height, on a lot having an area of about 20,000 square feet. It is constructed so that it will be capable of further extension to a height of 24 stories. The building throughout is of the very latest type of fireproof construction, and by competent municipal authorities in New York familiar with such matters it has been often cited as the best example of fireproof construction known to them. The long-distance switchboard itself, located in this building, is by far the largest in the United States. In fact, it is much the largest long-distance switchboard in the world. This switchboard at the present time consists of 274 positions, and is designed so that it may be extended to 700 positions, and even beyond that point, as the growth of traffic calls for such extensions. In this switchboard there are incorporated all of the very latest improvements and methods known in the art, and in connection with its design many special problems arising from the great volume of traffic and the complex conditions to be met were successfully worked out by the engineers.

The extraordinary increase in the number of telephone wires raises from time to time many interesting and important questions for the solution of telephone engineers. During the year 1914 work on this problem has resulted in the development of a new type of cable, containing 2,400 wires, arranged to provide 1,200 metallic circuits, and all of this within dimensions which would permit of the use of such cable in underground ducts having a diameter of three inches. A service trial of this cable is about to be made, and it is expected that the results of this trial would be such as to justify the use of this type of cable in locations where there is serious congestion, and where wires in such quantities are required.

The present war in Europe has

brought up many interesting problems for telephone engineers and manufacturers. While the American Telephone and Telegraph Company does not in its system employ any apparatus or finished materials which are imported, it is necessarily dependent for certain classes of raw material upon the supply from abroad. High-grade contact metal and certain materials used in underground cables and in condensers are illustrations of such material, the supply of which in part, or as a whole, comes from outside of the United States. The problems concerning materials, in regard to which there was any threatened shortage, are being solved so that should this shortage become a reality the substitute methods and materials will be available, and the growth and development of the Bell telephone system may continue unaffected.

For several years careful investigations have been carried on of an improved form of local switchboard, including the machine ringing of subscribers, the use of automatic listening keys, and other allied features, and several installations of that type were completed during the year. The operation of these equipments has been successful, and the new type of switchboard will be largely used for single-office districts, and probably also for small multi-office districts.

In cable telegraphy nothing of an important nature appears to have been developed. Experimental work in the direction of new developments has been undertaken by several experts, and some of this work appears to promise successful results the practical application of which will probably come during the present year.

Wireless Telegraphy.

One of the most important developments in wireless telegraphy concerns the high-power long-distance work inaugurated with the long-distance circuits of the Marconi Company. This marks the starting point in the development of commercial work through long distances. Another interesting development is that in the construction of small continuous-wave generators, used for short-distance work both for telegraphy and telephony. These are the so-called "gas relays." By this means the Marconi Company has been able to evolve a wireless telephone set, which is being used for distances up to 30 miles, and which is being developed for even longer distances. The fact that these relays can be made to produce oscillations is an enormous step forward in the art. A significant development along this line is that which has been made by Peter Cooper Hewitt, who has succeeded in producing an oscillator or vacuum generator of alternating currents of any frequency, producing these currents from direct current. This vacuum generator has been operated at all frequencies up to over 50,000 periods a second. It is still, so far as its development goes, in the laboratory state, but Mr. Hewitt announces that he sees no reason why its power limit should be less than that of the Cooper-Hewitt rectifier. It is easily controllable, and is controllable electrostatically, electromagnetically and physically. Its performances are said to be extraordinary beyond belief. With reference to Mr. Hewitt's amplifier and wireless receiver, consisting of a vacuum tube, recent tests have indicated that it is more sensitive than a Perikon detector, and it possesses certain other inherent practical advantages.

The past year has seen daily service established between the San Francisco (Cal.) and the Honolulu stations of the Federal Telegraph Company, using the American-Poulsen system. Dr. de Forest states that the system has been enlarged, and made astonishingly reliable, and is by far the most convincing evidence yet advanced that radio-communication will eventually surplant the submarine cable.

Of more popular notice, on account of her otherwise almost total isolation from western telegraph communication, is the remarkable wireless service between Germany (Nauen and Hanover stations) and the American stations at Sayville, L. I., and Tuckerton, N. J. At the latter station, since its operation by the United States government, direct comparison is had between the long-distance efficiency of the Goldschmidt high-frequency alternator and the 100-kilowatt arc. Both methods have proven to be remarkably efficient for daylight communication over distances of 3,000 to 3,500 miles.

In the opinion of radio authorities of the United States Government the greatest improvement in the art of receiving wireless signals has been the introduction of the "Ultraudion" or oscillating Audion, particularly in connection with large undamped-wave stations. This detector, possessing a sensitiveness from five to 20 times that of any of its predecessors, brings in these signals as clear musical notes, the pitch of which can be varied to suit the needs of the receiving operator.

By its means morning signals from Nauen, Germany, are received on a small antenna at the Bureau of Standards, Washington, D. C., with several thousand times audibility.

The combination of undamped-wave generators of great power and such undamped-wave receivers, furnishing at once the maximum of sensitiveness and of security from interferences and static, has this year ushered in a new era of commercial radio communication, of which men have for more than a decade been dreaming.

During the year announcement was made of the successful establishment of wireless communication between stations at New York, Scranton, Binghamton and Buffalo with the limited trains of the Delaware, Lackawanna & Western Railroad, operating between New York and Buffalo.

The United States Government is at work erecting the three 600-foot steel towers near Gatun Locks, Canal Zone, Isthmus of Panama, for supporting the antenna of the Panama wireless telegraph station. Toward the end of the year announcement was made of the successful operation by John Hays Hammond, Jr., of a radio-controlled torpedo boat.

There was granted on December 1 to Nikola Tesla a patent for an apparatus for transmitting electrical energy. This application was filed in January, 1902, and renewed May 4, 1907. This patent relates to a system for the distribution without wires of large amounts of electrical energy over considerable distances.

Mr. Tesla's researches in this field have attracted world-wide attention and his is undoubtedly the master mind so far as magnitude of conception of the possibilities of such a system is concerned. Mr. Tesla is sanguine that this is the greatest thing he has ever done, and that the world will shortly witness the practical working out of the system which he has devised.

The utilization of wireless telegraph and wireless telephone instruments in the war now raging in Europe has attracted a great deal of attention recently, and authentic information is slowly coming to hand with regard to the important part that this system of communication is playing. It can be said, without fear of controversy, that the utilization of these agencies of communication has, to a great degree, revolutionized the methods of warfare both on land and at sea. Grave questions of neutrality have also been involved, and it has become expedient for the United States Government to exercise a close censorship over all wireless stations, and its rights in this direction are now the subject of litigation in the Federal courts.

Electrochemistry and Batteries.

While no epoch-making work in electrochemistry has been done during the year 1914, there has been steady progress in the development of paths already hewn in former years. Many details have shown advance, and some of these are noteworthy.

The formation of commercial nitrates by the electrolysis of peat, which was proposed by A. Nodon, has been demonstrated in France as a feasible process. Under European conditions this process might even be a financial success, but the figures given out for costs and quantitative results do not indicate that such a method could be profitably operated in this country.

A new form of electrolytic meter has been brought out by H. S. Hatfield, in England. Current passing through it transfers hydrogen from one arm to another, where it is measured. Being in series with a comparatively large resistance, the combination being shunted, it is little affected by temperature, as well as being free from the usual errors of electrolytic meters.

The electroplating of cadmium has been accomplished by Prof. F. C. Mathers and his assistants at Indiana University, and the conditions affecting lead plating more thoroughly investigated. The use of so-called addition agents of an organic nature seems to be essential to successful results.

A method of plating zinc on iron pipe has been patented, thus giving us a new form of galvanized conduit. The feature of this process is a first coating of copper and zinc together, followed by a coating of zinc.

The insulation of aluminum wire by the electrolytic production of a coating of oxide or other compound on the surface has passed beyond the experimental stage and is now a commercial process. This, combined with the method of electro-percussive welding of Messrs. Skinner and Chubb, should lead to the still larger use of aluminum for motor windings and similar purposes.

The precipitation of dust from smelter fumes by the Cottrell method of high-tension discharge has found practical application at the Anaconda and Garfield smelters.

The electrolytic separation of the metals of the yttrium group has been accomplished.

An electrolytic process has been perfected for the manufacture of tubular copper radiators, of especial importance to the automobile industry.

The commercial production of electrolytic iron is being carried out at Grenoble by the Compagnie Le Fer and a similar enterprise is planned in England, under the patents of S. Cowper-Coles, for producing sheets and tubes. For tubes the kathode consists of a revolving mandrel in a neutral solution of iron salts made up from pig iron. The metal has a high degree of purity, and after being annealed to remove occluded gases is less brittle and hard, and has a satisfactory strength. The electrolytic iron competes with the best Swedish iron for the making of special steels.

The electric furnace continues to meet wider and wider applications. New forms or modifications of furnaces appear at intervals. Among these are promising types for the smelting of zinc, a process which heretofore has given considerable trouble, but now seems about to be met with commercial success by the electric method. Applications of the electric furnace are also being extended, its conditions of operation being found suitable to more and more uses. A number of steel mills have installed electric furnaces, the ease and accuracy of control being greatly appreciated. At Lebanon, Pa., the American Iron & Steel Manufacturing Company placed an order at the close of 1913 for the largest furnaces of this kind yet constructed. There are to be two furnaces of the Frick type with a capacity of 20 tons each. They will operate at 5,000 volts, five cycles, single phase, consuming 1,800 kilowatts each. These are not yet in operation. They are intended for refining steel.

The practicability of producing steel directly from iron ore in the electric furnace was again demonstrated by tests reported to the Iron and Steel Institute by Humbert and Hethey. A high grade of steel may be thus produced and the cost will not exceed that of electrical steel made from pig iron, but will probably show a saving.

A new product of the electric furnace is a silicidized carbon known as silfrax, due to F. J. Tone. This promises to be a valuable refractory.

The Hering furnace has proved especially suitable for brass melting and has been made in larger sizes for that purpose. In Scandinavia the Rennerfelt furnace has met with much favor and been widely used.

A new form of laboratory furnace has been described by E. F. Northrup. It is especially suited to attaining high temperatures which are uniform throughout a tubular space. Graphite in an atmosphere of carbon monoxide is the resistor used.

The use of tungsten and molybdenum for furnace resistors, on account of their high melting points, has proved advantageous, but for high temperatures an atmosphere of hydrogen must be maintained about them. The Coolidge patent for ductile tungsten was issued in the closing days of 1913. Its principal claims cover the process of producing tungsten having a fibrous structure by repeatedly working while hot the crystalline metal, regardless of how this is obtained. In May a patent was taken out by Schwarzkopf and Burgstaller for achieving the same result of ductility by maintaining the tungsten in an atmosphere of hydrogen at a temperature of about 2,700 degrees centigrade.

The use of the Coolidge X-ray tube in medical work has proved very advantageous. This tube uses tungsten for both kathode and anode (which is also the anti-kathode), but its distinguishing feature is the maintaining of the kathode at a high temperature by means of an auxiliary current. This permits a high vacuum, definite and constant working conditions, adjustability and maintenance of "hardness" (wave-length) of the X-rays, and reproducibility of conditions and results.

In this connection the use of X-rays in investigating crystal structure may be mentioned. Much has been accomplished in this direction during the year by Bragg and others, and our knowledge of the ultimate structure of matter, which once seemed an impenetrable realm, is increasing each year through the use of electrical methods and study of electrical phenomena.

Little of accomplishment in connection with batteries has been recorded during the year. The improvement of incandescent lamps has led to the commercial introduction of new models of flashlights supplied by portable dry cells, and to similar outfits of longer life for more steady use. A number of these have been brought out during the year.

It has been shown that the effect of alternating current upon a primary cell is to prevent polarization, and thus increase its available capacity.

There has been no radical change in the plates used in storage batteries, but details in their assembly have been altered to better fit them for the use in increasing numbers in automobiles and submarines. The demand for batteries for isolated lighting plants steadily increases. A cheaper form of Edison cell, which has been looked forward to in connection with the popularization of the electric passenger vehicle, has not yet appeared. It should be noted, however, that an electric wagon, suited to light commercial use, has been put on the market at as low a price as $750. Slight changes in other models are reported, and one vehicle has been put on the market with an electric transmission between engine and driving gear.

Electric Railways.

Perhaps no branch of the electrical industry has more keenly felt the effects of the European war than the field of electric traction, yet a careful analysis of the progress during 1914 discloses the fact that substantial gains have been made in many directions. Of course there have been fewer new projects than in late years and several contemplated extensions had to be temporarily abandoned, but in general the financial returns for 1914 will compare favorably with the preceding year and there have been also several important engineering developments of considerable significance.

From every standpoint the most important happening of the year was the starting of work on the electrification of two engine divisions of the Chicago, Milwaukee & Puget Sound Railway. In the first place the contracts for this work involving over $3,000,000 were let early in November, at a time when business conditions were at their worst. Not only did the announcement of the company indicate its confidence in the immediate return of better conditions but a noticeable improvement in conditions in other lines followed.

This electrification is without doubt the most important and extensive ever undertaken in the United States. The initial electrification of 113 miles is the first step toward the electrification of four engine divisions covering a distance of 440 miles and involving an outlay of approximately $12,000,000. Power for propulsion will be furnished at 3,000 volts direct current, the total supply being obtained from the Montana Power Company. The locomotives will be the most powerful ever built for either steam or electric service. (A complete description of this project appeared in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for December 26.)

Progress has been made on the electrification project of the Norfolk & Western Railway and successful tests of the single-phase-polyphase system to be used have been made. This system employs a split-phase motor between the line and driving motors to change single-phase to polyphase current. It is not a motor-generator set but a straight induction motor run as a single-phase motor with additional windings so interconnected that polyphase current can be supplied to the traction motors. This motor is kept running continuously and power supplied to polyphase motors only when the car is operated. The polyphase induction motor, because of its simplicity and ruggedness and the possibility of regeneration of power, possesses ideal characteristics for heavy electric traction. The chief disadvantage is the complex distributing system necessary and the trouble in collecting current. The use of the split-phase motor makes possible the use of polyphase motors with single-phase distributing system.

Another significant development has been the use of a mercury-arc rectifier equipment in a locomotive operating on a branch of the New Haven Road. The equipment consisted of a transformer for lowering the alternating-current line voltage from 11,000 to about 1,200, with secondary taps for use in varying the voltage; two single-phase rectifiers, one for service and one for reserve; four direct-current motors of 1,000-horsepower combined capacity, and the necessary control apparatus, rectifier exciter, etc.

This demonstration was for the purpose of developing the rectifier-locomotive equipment for the Pennsylvania Railroad, and it is installed on a combination baggage and passenger car furnished by that railroad. The reason for installing the equipment on a car in this instance was to secure in the readiest manner possible railroad operation with an equipment of substantial size. This car was first tried out on the Westinghouse Company's test track near Pittsburgh.

It is said that this rectifier car development will eventually prove to be far reaching. By it, the advantages of high-voltage single-phase transmission to the locomotive is retained. On the locomotive itself, economical speed control is obtainable over any range whatever by alternating-current control of the voltage to the rectifier, while the extremely sturdy qualities of the direct-current motor are obtained. For mixed alternating current-direct current service, the rectifier car or locomotive is ideal if the usual direct-current control is used for both alternating-current and direct-current operation, instead of alternating-current control for alternating-current operation and a different control for direct current. When a common control is used for both, the arrangement is about the simplest that can possibly be conceived for two kinds of service.

It is frequently suggested that rectifiers in substations will be a solution of the railway problem. However, at high-voltage direct current (2,400 volts or higher) the rectifier does not modify the serious part of the problem in any way. It simply takes the place of the motor-generator or rotary converter. It therefore might cheapen the cost of electrification, to a slight extent, but would not change the nature of the problem itself. However, on locomotive, the rectifier changes the nature of the whole problem, and before very long, the problem of rectifier locomotives will become a very active one. The experience with the New Haven equipment, above referred to, has proven very definitely the practicability of the rectifier on a locomotive or car.

General progress is being made in the plans for terminal electrification at Philadelphia by the Pennsylvania Railroad. The initial step provides for the electrification from Philadelphia to Paoli. Suburban traffic only will be handled. Standard steel coaches will be used. Single-phase system will be used.

In the field of interurban and suburban traffic several important developments have taken place. The Mesaba Railway was completed and placed in operation during the year. This is a 35-mile line devoted exclusively to passenger traffic in the Minnesota iron district north of Duluth. The power supply is 725 volts, direct current.

The Salt Lake & Utah Railroad running between Salt Lake City and Provo, a distance of 48.5 miles, was opened during the year and has proven very successful. Direct current at 1,500 volts is employed.

During the year the Pittsburgh & Butler Street Railway operating between the two cities was changed from single phase to 1,200 volts direct current.

Additions were made to the system of the Portland, Eugene & Eastern Railway, comprising 109 miles of 1,500-volt direct-current track. In Texas a 151-mile 1,200-volt direct-current system known as the Southern Traction Company was completed and adds another link to the chain of interurban lines radiating from Dallas.

Substantial progress must be reported on work for the new 2400-volt Kalamazoo-Grand Rapids line of the Michigan United Traction Company, which will connect these two cities. The line will be 92 miles long.

In the field of subway and elevated transit the most important happening during 1914 was the awarding of seven subway-construction contracts for New York City. These involve $11,106,038. Minor extensions have been made elsewhere. Many elevated lines have improved their service and added new equipment. In Chicago the results of the merger of all elevated lines has proven very satisfactory and considerable congestion of traffic relieved. Steel cars are being used to a greater extent than ever before.

Surface lines made the usual progress during the year and many new shops, barns, and power houses were erected. A consolidation of all surface lines in Chicago was effected, which makes the combined interests the largest surface electric railway system, in gross earnings, in the world.

The annual convention of the American Electric Railway Association was again held in Atlantic City, October 12

to 16, and as usual was one of the important events of the year. The growth of the industry is reflected in these annual conventions.

No review of the year would be complete without reference to the increased interest and activity in accident-prevention work. There is now hardly a road of any size that has not done a great deal in the way of education and legislation to increase the safety of transportation.

Electric Lighting and Illuminating Engineering.

Although the past year was not productive of any revolutionary innovations in electric lighting, it saw the carrying out of some very important developments that were anticpated in 1913 and also the active stimulation of movements for the still more extensive use of electrical illumination. Progress in the improvement of light sources continued, together with a more general following of correct principles of illumination in the utilization of these light sources.

Most important of the developments in illuminants was the actual introduction on a commercial scale of the gas-filled tungsten-filament lamp. Much was anticipated from filling the bulb with an inert gas so as to permit operation at a greatly increased temperature and much has been achieved by this in the way of improved efficiency and increase in the maximum candlepower attainable by incandescent lamps. Both these have broadened the field of the glow lamp, partly at the expense of its rivals in the arc-lamp line. The range of sizes of both series and multiple lamps of this type has been increased from time to time through the year and the efficiency of each size slightly improved. Some of the early lamps showed imperfections that gave rather poor life. As the lamps were guaranteed for a certain period, however, defectives were generally replaced by the manufacturers. With the perfection of manufacturing processes, the later lamps were turned out substantially free from imperfections and have given very good account of themselves.

It was believed a year ago that the best results would be obtained from the new lamps when used on series circuits for street lighting. This has been found to be the case, experience proving that the larger lamps with relatively thick filaments taking 20 amperes gave an efficiency of one-half watt per candlepower and an excellent performance as regards general operation and maintenance. In order to obtain this efficiency these lamps must be supplied with 15 or 20 amperes by some sort of individual transformer or compensator, if the line is the customary 6.6, 7.5, or 9.6-ampere constant-current circuit. For this purpose autotransformers have been supplied in the upper part of the fixture; two-coil transformers are also being made for this service. In either case the transformer or compensator pays for itself in the improved lamp efficiency attainable and at the same time serves in place of a film or reactance cutout to maintain the line circuit unbroken should lamp outage occur.

Although the smaller series street lamps do not give as high an efficiency, they have been found very satisfactory units for street lighting. They have good color value, give a very steady light and require little attention, patroling and occasional cleaning being only necessary. In all these respects they are superior to arc lamps and it is not to be wondered at that the older types of arc lamps are rapidly being displaced by the new gas-filled incandescent units. Even the most efficient types of arcs, the flame arc lamps, have met in the new larger units a formidable competitor. In Chicago it has been found that a 300-watt gas-filled tungsten unit is a fair rival of a 460-watt flame arc, giving practically the same average useful light flux at about the same total cost. Many thousand of the new lamps are being installed in that city in place of old types of arcs and instead of flame arcs that it had been intended to use in extensions, although the flame lamps now in use are not being discarded (see ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of September 12, 1914). Other cities are also reporting that the elimination of trimming and reduction of attendance costs offsets the charge for lamp renewals and gives the new lamps precedence over arc lamps.

In connection with the gas-filled street lamps an ingenious form of double prismatic reflector with smooth surfaces for ready cleaning has been developed which gives a much broader lateral distribution of the flux and therefore more uniform illumination. An amplified form of this gives a greater distribution longitudinally on the street than transversely and still further improves the illumination.

In practically all cases the new street lamps are inclosed in either a refracting globe of the type described or in a diffusing globe of opalescent or similar glass; in some cases both refracting and diffusing globes are used. It has been found that the globe in each case is quite uniformly luminous, giving a pleasing aspect to the outfit and therefore making it peculiarly appropriate for mounting on top of an ornamental column or post. This type of ornamental street lighting is very much more economical than that with the commonly used clusters of regular tungsten lamps and bids fair to be used in future installations extensively.

The multiple 110-volt gas-filled tungsten lamps have been developed and employed nearly as much as the series lamps. Their efficiency is not quite as good as that of the series type, but these lamps have been found to fill a need in the form of more powerful and more efficient multiple incandescent lamps. Many installations have been made in front of theaters, hotels, public buildings, etc., where a large, attracting and yet economical lamp was wanted that did not need so much attention as the arc lamp. For flood lighting of facades and the illumination of depot trainsheds, yards and other large open or semi-open places these lamps have also come into considerable use.

In indoor service multiple gas-filled lamps are being employed in several large department stores, large offices, factories, mills, armories, and other interiors with high ceilings and large floor areas, where a powerful lamp can be hung to good advantage to give relatively high foot-candle illumination at comparatively low operating cost.

Other uses developed for the new lamps are for portrait photography and projection purposes. The steadiness of the light, together with its increase of actinic rays as well as efficiency has made the 1,000-watt gas-filled lamp equipped with blue bulb an excellent light source for portraiture work, giving as good results as the best daylight. Trials are also being made of gas-filled lamps for motion-picture projection which give great promise.

Along with the commercial development and utilization of the nitrogen-filled tungsten lamp, the past year has seen marked improvement in the vacuum type of tungsten unit. An increase in efficiency, ruggedness and reliability has occurred in practically all sizes of these older lamps and at the same time a decrease in price. These and other improvements in quality have been due to still further perfection of manufacturing processes and production on a much larger scale. To further stimulate the liberal use of electric light, many central stations have placed on the free renewal list tungsten lamps of 60 watts and over. All these facts are helping to increase electric lighting and give it still further preference over other illuminants.

The development of the helically coiled filament in 1913 has greatly increased the adaptability of tungsten lamps for many purposes, among which are projection work, signal lighting, portable lanterns and flashlights. This helical coiling permits concentrating the filament in a very small space at the

center of the bulb, which may, therefore, be more accurately placed at the focal point of a reflector or lens for concentrating the light rays into a powerful beam.

In the line of flashlights and modifications thereof alone there has been very decided development recently. A large variety of these are now available, many employing a single standard dry cell. Some of these outfits are in the form of hand lamps, lanterns, tiny pocket flashlights, etc., all being extremely convenient for a multitude of uses and helping decidedly to promote the "Safety First" movement by eliminating the use of matches and flame lamps in dangerous places.

Before leaving the subject of tungsten lamps, mention must be made of the argon-gas-filled lamp, which had been introduced commercially on a small scale abroad before the war broke out. This lamp is a development of the nitrogen-filled lamp but employs argon instead of nitrogen. Its efficiency is somewhat higher than that of the lamp already in use; its general characteristics are quite similar. Difficulty in obtaining pure argon has retarded this unit. Still greater difficulties are met with in perfecting the incandescent lamp filled with mercury vapor, which, if overcome, promise still higher efficiency

One important feature connected with the use of all gas-filled lamps has been found to be the need for effective ventilation of the fixtures in which they are used. For this reason they have nearly always been used in fixtures specially designed for this service. A great variety of such fixtures, both for the series and multiple lamps, have been brought out during the past year, together with special socket and receptacles, nearly always of the mogul-base pattern. The considerable heating of the new lamps has somewhat restricted their use, this being prohibited in show windows and confined inclosures in several cities to eliminate any fire hazard due to this heat.

Another matter to be mentioned before leaving incandescent lamps is the attempt initiated a few months ago to standardize lamp-circuit voltage. Drawn-wire tungsten lamps can be produced with such close approximation to rating that the former need for a variety of voltages, to utilize the lamps that deviated considerably from the rating intended, no longer exists. By standardizing on a single voltage, say 115 volts, or at most only a few voltages, instead of the full range from 100 to 130, reduction in manufacturing cost can be effected and consequently further reduction in price achieved.

Among the various types of arc lamps there is not so much development to record. An improved electrode and operation at slightly higher voltage has considerably improved the efficiency of the magnetite arc. This type of lamp has found considerable vogue in ornamental street lighting, particularly in the East. The lamps are placed on top of ornamental columns of more or less classic design and make a very attractive combination. The white light of the lamps, together with their excellent light distribution, which is sometimes further enhanced by a prismatic reflector, makes them peculiarly suitable for street lighting.

Some detailed improvement has also taken place in the flame arcs and one type of these has been brought out for use on top of ornamental pillars, similarly to the use of magnetic arcs just referred to. In some quarters, however, flame arcs are not looked on with such favor as a few years ago, partly on account of their flickering, the deposit of condensed fumes on the globe cutting down the useful light, and the troublesome trimming they necessitate.

Nothing need be said of other types of arc lamps, except that the older ones are rapidly being replaced by high-efficiency tungsten lamps and other less troublesome and more economical units. The same is largely true of carbon incandescents.

As to mercury-vapor and other gas-tube lamps there is not much new to record. The quartz lamps, as well as other mercury-vapor lamps, have maintained their reputation as highly efficient light sources which promote acuity of vision. A new use for the quartz lamp has been its installation on top of high towers for the illumination of a large railroad yard.

An important feature necessitated by the more extended use of lamps of very high efficiency, which almost invariably are also lamps of extremely high intrinsic brilliancy, is the imperative need for preventing excessive and very injurious glare from this high brilliancy. This has resulted in the use of these lamps with diffusing or refracting globes, or at least with reflecting shades which more or less screen the lamp as well as redirect its light. Many of the newer lamps are used in indirect fixtures, thus removing this difficulty completely and making a fairly efficient combination.

This need for eliminating glare is only one of the features of the high-efficiency lamps that necessitates some consideration of the principles of illuminating engineering. The development of each new powerful light source compels on the public a greater appreciation of the desirability of scientific advice in order to get the proper and best possible use out of these high-power lamps.

Such a tendency has been gradually developing during recent years and 1914 saw a great extension of it, accelerated no doubt by the gas-filled lamp. To promote this tendency further, there has been inaugurated on the part of the Illuminating Engineering Society a broadened publicity propaganda on the principles of correct illumination.

Through the development of new light sources and fixtures for their utilization, the illuminating engineer has had placed at his disposal a greater variety of equipment to more exactly meet the widely varying requirements of different installations. One of the recent developments of more than scientific interest is the bringing forth of several variations of so-called daylight glass, which, when used with modern high-efficiency sources, screen out excess radiations in different parts of the spectrum to give a very close approximation of average daylight. This is of considerable value in color-matching.

In concluding this hasty review, brief mention must be made of the inauguration of an important movement aiming to universalize electric lighting. An extended investigation was made, on behalf of the National Electric Light Association, of conditions in Europe and it was found that in many cities there electric light was supplied with profit to even the poorest inhabitants. A study is now being made of means to permit a similar extension to very small homes in this country. This problem is not one of illuminating engineering, rather it is a problem for the central-station and construction engineers to devise ways for supplying the smallest consumer at minimum expense. That some developments along this line may be expected in 1915 is anticipated by many, who have given thought to that subject. The aim at any rate is to make available to rich and poor alike the usefulness, convenience, economy and safety of electric light.

Electrical Machinery.

The year 1913 was not one productive of radical developments in electrical machinery. Rather it was one in which progress can be recorded in the way of trying out and perfecting apparatus along lines already established. In this manner splendid achievements have been made, which though not startling in nature, are distinct advances in giving us a better knowledge of what may be done in actual practice with various improvements proposed.

The increasing size of turbogenerator sets for large central stations de-

Estimated Values of Materials For Use In Electrical Industry.

ARTICLES.	FOR THE YEAR— 1911.	1912.	1913.	1914.
Arc lamps and appurtenances	$3,000,000	$3,000,000	$2,000,000	$1,500,000
Auxiliaries, steam, for electrical installations, such as pumps, condensers, separators, feed-water heaters, injectors, piping, etc.	3,000,000	3,500,000	3,250,000	2,500,000
Bells, buzzers, push-buttons, call-boxes, annunciators	2,000,000	2,000,000	2,500,000	2,500,000
Boilers for electrical plants (water-tube)	4,800,000	5,000,000	4,500,000	3,600,000
Boilers for electrical plants (other than water-tube)	3,000,000	3,500,000	3,000,000	3,000,000
Cables, underground, aerial and submarine	13,000,000	16,000,000	15,000,000	12,000,000
Carbons for lamps, batteries, brushes or other electrical purposes	5,000,000	5,500,000	8,000,000	8,000,000
Circuit-breakers	2,000,000	2,500,000	3,000,000	2,100,000
Conduits (underground) and similar material	750,000	1,500,000	1,000,000	750,000
Dynamos and motors, including parts of machines, boosters, balancers, rotary converters, motor-generators, etc., and all motor applications, such as in automobiles, not specifically enumerated in this list	80,000,000	100,000,000	110,000,000	80,000,000
Electroplating and other electrolytic apparatus not elsewhere specified	1,000,000	1,200,000	1,400,000	1,400,000
Electrostatic machines, induction coils, medical sets, etc.	700,000	800,000	500,000	500,000
Elevators, electric (mechanism only)	2,500,000	3,500,000	4,000,000	3,500,000
Engines, gas or gasoline or oil, used to drive electrical machinery	12,000,000	14,000,000	8,000,000	8,000,000
Engines, steam (reciprocating), used to drive electrical machinery	10,000,000	11,000,000	6,000,000	6,000,000
Fans, electrically operated and direct-connected	2,250,000	2,000,000	1,700,000	2,000,000
Fire-alarm apparatus, also burglar alarms, crossing indicators, etc.	900,000	1,000,000	1,250,000	900,000
Fixtures for electric lighting	12,500,000	20,000,000	15,000,000	15,000,000
Fuses	1,500,000	1,000,000	1,500,000	1,100,000
Glassware, electrical	3,500,000	6,000,000	6,000,000	5,750,000
Heating and cooking apparatus, electrical	2,500,000	4,000,000	6,000,000	7,000,000
Incandescent lamps (carbon or metal filaments)	19,000,000	22,000,000	23,000,000	23,000,000
Instruments for measurement and meters, of all kinds; also ground detectors, scientific and laboratory apparatus, photometers, Leyden jars, X-ray outfits, etc.	2,400,000	7,000,000	6,500,000	5,000,000
Insulating material, fibre, tape, etc	3,000,000	5,000,000	6,500,000	5,000,000
Insulators (glass and porcelain)	2,500,000	3,500,000	3,500,000	3,000,000
Interior wiring supplies, as tubing, interior conduit, molding, junction boxes, rosettes, outlet boxes, etc.	4,000,000	5,500,000	5,000,000	4,000,000
Lightning arresters	500,000	600,000	650,000	500,000
Mercury-vapor lamps	800,000	900,000	900,000	900,000
Poles and wire towers, cross-arms, brackets and pins	5,500,000	5,500,000	6,500,000	5,000,000
Primary batteries	2,700,000	3,000,000	3,250,000	3,500,000
Railway supplies, electric, such as trolleys and other contact devices, strain insulators, cross-overs, rail-bonds, etc.	5,000,000	7,200,000	7,000,000	7,000,000
Rheostats, car controllers, motor starters, etc	5,000,000	6,500,000	6,000,000	5,500,000
Shafting, pulleys, clutches, etc., used in electrical generating plants	750,000	1,200,000	1,000,000	1,000,000
Signs, electric	2,000,000	4,000,000	3,200,000	3,500,000
Sockets, switches, cut-outs	6,000,000	7,500,000	7,000,000	7,000,000
Steam turbines, used to drive electrical machinery	10,000,000	14,000,000	14,000,000	10,000,000
Storage batteries, including those used in automobiles	10,000,000	12,000,000	15,000,000	14,500,000
Telegraph instruments and apparatus	600,000	650,000	600,000	500,000
Telephones, telephone switchboards and distinctively telephonic apparatus	20,000,000	16,000,000	18,500,000	16,000,000
Transformers, stationary	5,000,000	10,000,000	10,000,000	9,000,000
Water-wheels, used to drive electrical machinery	3,000,000	5,000,000	4,000,000	3,000,000
Welding apparatus, electric	200,000	400,000	500,000	600,000
Wire, bare	25,000,000	33,000,000	30,000,000	25,000,000
Wire, rubber-covered	15,000,000	18,000,000	21,000,000	18,000,000
Wire, weatherproof	13,000,000	15,000,000	15,000,000	10,000,000
Wire, all other electrical	5,000,000	7,000,000	10,750,000	10,000,000
Wireless apparatus	400,000	500,000	500,000	500,000

serves comment. Although no further increase over units of 35,000 kilowatts has been announced, largely due to business depression in the latter half of the year, the gigantic machines up to this capacity that were already ordered are being built and in some instances are being installed. To what extent they will bring about further economy in operation is uncertain. Test results of the two 25,000-kilowatt machines at the Fisk Street station of Commonwealth Edison Company, Chicago, gave very high efficiency; one of these is an American machine and the other is of British make. The building of similar and even larger generating sets will doubtless be continued, as their marked reduction in fixed charges per kilowatt, even if not in operating cost per unit, fully justifies their use in the largest urban central stations.

Closely related to central-station generating machinery is the improvement in prime movers for its operation. In this connection much study has been devoted to the development of the gas turbine and mercury turbine, but these have not yet reached the commercial stage. On the other hand, the steam turbine is steadily being improved in reliability and efficiency, likewise the hydraulic turbine and the Diesel oil engine, and, to a less extent, the gas engine.

No marked innovations have taken place in the smaller electric generators, both alternating current and direct current. However, improved ventilation and insulation of these machines has been given marked consideration. The advisability of filtering and cooling the air used for ventilating generators and transformers has been brought to notice and some equipment for this purpose installed.

Motors likewise have been improved and several new types of direct-current, single-phase and polyphase machines brought out, which embodied features of better construction not hitherto applied to their manufacture. A notable tendency is to make motors more rugged without increasing their size or weight by use of steel frames in place of cast iron. The increasing use of motor-driven centrifugal pumps has called for greatly improved insulation, and this has been provided so effectively in some motors that they may be operated a long time almost or even quite submerged. Commutating poles are more generally used on direct-current motors, particularly of the railway type, which are more fully discussed in the review on electric railway developments. A considerable number of small motors designed for driving household and similar appliances have been brought out and these give the manufacturers of portable tools, washers, vacuum cleaners and other small power appliances a much better assortment of driving motors from which machines best adapted to their purpose can be selected.

In the way of power applications on a larger scale much extension has taken place in motor drive of pumps, factory and mill machinery. Synchronous motors have been used to an increasing extent in the operation of compressors, pumps and other machinery where an experienced operator is available. On long and important transmission systems they are being used at the receiving end as voltage regulators to maintain substantially constant voltage at the substation. For general power service, however, the induction motor not only remains in greatest favor, but is continually being used for purposes where an alternating-current motor was formerly thought impractical.

Through the perfection of control equipment electric drive of much machinery has been made possible. This has notably been true, during the past year, of alternating-current motor-driven excavating machines, refrigerators, machinery on shipboard, etc. A very simple type of remote control is now used for the electric operation of rudders. In some directions there has been a further tendency to amplify automatic motor control with additional safeguards. In other directions a tendency is recently shown toward simplifying rather than complicating the functions of control apparatus. This is in line with the belief that it is not well to have too elaborate automatic features, reliance on which in a critical moment may possibly produce failure.

In the line of synchronous converters there is a growing use of commutating poles. A large number of 4,000-kilowatt railway converters were installed. This type of machine has not increased in size, but is giving an improved operating performance. Motor-generator sets and boosters also show no marked development aside from details of design and construction. In mercury-arc rectifiers there has been an important development in the successful trial of a metal-bulb rectifier capable of handling 1,000 kilowatts. This gives particular promise in operation of direct-current railway motors on alternating-current lines.

Transformer development of the past year has been unusual in that neither the high-voltage record nor the high-kilovolt-ampere record has been exceeded. However, a 7,500-kilovolt-ampere core-type transformer was built, the largest of this type. A power transformer with the highest commercial ratio of transformation, 110,000 to 377 volts, was also built. An interesting combination of self-cooled and water-cooled unit was also produced. The tendency has been to design transformers for high reactance and so that they will mechanically withstand short-circuit strains.

Of auxiliary equipment, such as oil circuit-breakers, lightning arresters, outdoor switches, etc., little need be said in a hasty review. The oil tanks of circuit-breakers have been strengthened to stand violent short-circuit stresses. A new form of horn-gap arrester with graded resistances is being brought out. The use of high-tension outdoor switching equipment has been greatly extended with excellent results. This and the practicability of other outdoor protective equipment has made possible the erection of low-cost outdoor substations that are stimulating the use of electricity in rural districts and very small communities supplied from high-tension power lines.

General Survey.

Owing to the use of voltages up to 150,000 in long-distance transmission of energy interest in insulation and protection problems continues. A number of valuable papers, giving the results of researches along these lines, have been presented during the year to the American Institute of Electrical Engineers. The breakdown strength of air is better understood. There is a distinct trend towards the adoption of more scientific methods of dealing with the problem of design of high-tension insulators and the methods of insulating high-voltage transformers. The former are now constructed with the stress evenly distributed. The proper methods of test are better understood, and the supposed aging of insulators has been shown to be due to mechanical defects. With proper ingredients, proper design and correct treatment, insulators can be turned out which will give permanent service with few failures. Insulators should, however, be periodically tested in service to detect faults before breakdown, and apparatus for this purpose is now available.

Outdoor transformers and switching have become more firmly established, and are being extensively used. Portable substations find wider favor. The use of synchronous condensers and rotaries for regulating voltage, as well as controlling power-factor is finding

wider adoption, and may be regarded as a regular feature in future installations.

A number of new instruments have been brought out during the year, among which may be mentioned a reactive-factor meter, a direct-current ammeter, depending upon magnetic flux for its indication, and thus not requiring connection in the electrical circuit, a recording electric tachometer, a long-distance indicating and recording system, and a combined watt-hour and demand meter.

The adoption of the new Standardization Rules by the American Institute of Electrical Engineers is important in several respects. It substitutes a single maximum rating for the ambiguous method previously in vogue; it classifies insulating materials and sets definite limits of operating temperatures for the several classes; and it includes in the rules fields heretofore not covered. For the measurement of high voltages the sphere gap has replaced the needle gap. Methods for determining temperature are specified, and the entire subject of testing and rating has been put upon a more scientific and rational basis.

As was pointed out in the beginning of this review, opinion is very much mixed as to the extent of the depression of the last six months with regard to the volume of business transacted during the year. The accompanying table has been compiled from estimates furnished by the leading manufacturers of the electrical material referred to. Where there are so many signs of a misleading character it is indeed difficult to reach close approximations with regard to the value of the material manufactured by so many diversified interests. It has been peculiar that a number of the smaller manufacturers of electrical apparatus have had a singularly prosperous season. To many others the record of the year is one of considerable decrease in both the volume and the value of its products manufactured and disposed of. In practically every line there has been a decrease in volume and value, and this holds fairly constant over a wide range. The slump in November and December has been announced to be the worst that has been experienced in several years. For the larger companies it is estimated that incoming orders are being received at the rate of about 75 per cent of those received during the previous year. It may fairly be estimated that with the exception of incandescent lamps, wiring devices and prime movers there has been a horizontal decrease of between 22 and 25 per cent. A few articles show an increase for the year.

Early in the year electrical construction for new buildings, wiring of existing buildings and for commercial and industrial applications, was rather slow, with a paradoxical increase in August, September, and October. The last two months in the year, however, witnessed a great decline in electrical construction, and the demand for equipment of this sort was consequently very light. Electrical inspection rules have continued as heretofore, with the promise of a period of considerable activity between now and the meeting in March of the Electrical Committee of the National Fire Protection Association. This committee meets every two years for the purpose of revising the National Electrical Code. There has been lately a disposition to simplify some portions of the Code, where the factor of safety was unnecessarily high, to the end that a cheaper system of wiring might be available. The probability of the Code being so revised as to permit the use of a concentric wiring system, such as has been in use in Germany and England, consisting of an insulated conductor and an outside continuous metallic sheath, has stirred manufacturers of standard wiring devices to great activity.

Electrical Affairs in Great Britain During 1914.

By Albert H. Bridge.

The year opened well in practically every department and save for strife in the labor world there appeared to be few rocks ahead. Whatever happened in other walks of life, electrical applications promised to progress, and the writer believes that in the notes that follow he has brought together a record of steady work and progress which, if it had been allowed to continue as it had proceeded up to the end of July, would have stamped 1914 as the best. But strife in the labor world was silenced at prospect of and in presence of international strife of the bloodiest kind that civilization (?) has ever seen, and though the electrical world has followed its normal course with wonderful consistency, the war atmosphere overhangs everything.

There has been greater activity in connection with electric vehicles than in any previous year. The co-operative efforts on the part of electric supply authorities and those interested from the manufacturing side have begun to bear fruit. In addition to the adoption of a two-cent battery-charging rate by a large number of works, publicity efforts have been used and public demonstrations or parades made in several centers on special occasions which are bound to bear good fruit. Many towns are setting the traders an example by employing electrics for the municipal services, some of them after first making exhaustive comparative tests of different systems. Barnes, in considering whether to displace horse-drawn refuse carts by battery-driven cars carrying one ton and costing $2,600, found that five such vehicles would replace 10 horse carts with a saving of $1,000 per annum. Birmingham ordered two electric refuse carts at $2,750 each. Hounslow and other places have taken similar steps. Electric supply departments are employing electrics for their own purposes wherever the managers can secure authority to do so, and some that have taken such action during the year are Marylebone, Croydon, Edinburgh. Electric busses have been adopted by South Shields; Ilford municipality is the first tramway authority in England to use an electric tower wagon with battery equipment (225-ampere-hour battery); the General Post-Office made trials with electric delivery vans for the London district; petrol-electric busses have been adopted at Edinburgh; these are some of the year's achievements in this field. They may appear to be small to American eyes, but in England they are some of the very important signs of the real move forward which is thought to be at last upon us in this department of electrical activity.

In the heating and cooking section, progress has been far more substantial than in electrics. Manufacturers of apparatus have by big newspaper advertising efforts, along electric-iron trial-offer lines, done something to affect the public mind. Electric supply men especially through the Point-Five Association, have shown a very live interest in the problems, technical and commercial, that arise as efforts are made to develop this class of business. The production of many new lines of cooking apparatus—stoves, electric fires, etc., has been a marked feature of the year. Electrical exhibitions and demonstrations, local showrooms and electric houses moving from town to town, the opening of new installations at hotels and public restaurants; publicity literature and popular posters relating to electric kitchens, their good points, and what

the cooks think of electric cooking—all of these measures or methods have been availed of for popularizing electricity for "other purposes" besides lighting in the home, small and great, and in the kitchens of small restaurants and big hotels alike. The conviction is now pretty general among electric supply managers that it will be quite impossible to take anything like full advantage of the opportunity that the merit of the electric system presents without hiring-out or hire-purchase systems being approved by Parliament, and generally applied to assist the householder to secure his equipment without a considerable capital outlay. It is of interest to note that since the "Point-Fives" came into existence connections for about 10,000 kilowatts of cooking and heating apparatus have been made to our electric supply systems, 7,000 kilowatts being in private houses, the greater part of them fitted with apparatus on the hiring-out system by authorities which have not failed to exercise the powers of that kind already possessed by them. Toward the closing months of 1914 there was probably a bigger activity among makers of electric fire, heating and cooking apparatus than has ever been experienced. Works were turning out these manufactures to the utmost of their capacity. This was partly due to the demands for the camps of the new army in training in various parts of the country, and to big orders for the British navy, but it was also due to the developments of the private demand in many supply areas, this not yet showing the falling off which is expected when there is a cessation of spending on "luxuries" consequent upon war burdens.

Municipal electrical authorities and electrical contractors have not yet arrived at a settlement of their differences respecting the "further powers" that are sought by the former, powers that the latter still regard as threatening in certain respects, an infringement of the legitimate privileges of the private trader. Parliament has not yet granted those extended powers, and in view of the present national situation it would be unsafe to suggest that these differences will have any parliamentary settlement in times approximately near. Elaborate preparations had been made for a fairly big electrical exhibition at Bradford, by co-operation of the manufacturers' organization and electric supply interests, but like many other events this exhibition which was to have taken place in October and was to have given a boost to electrical applications in connection with the great industries of Yorkshire, as well as in domestic service, stands deferred until some date which cannot be settled for some time. Sheffield is still a sensitive spot in the relations of electric supply men and contractors, but the Corporation Electrical Department of that city has to its credit a useful move in the appointment of a lecturer to lecture on the art of correct illumination. A more authoritative lecturer came upon the scene in many important centers in the early autumn, in the form of the military authorities, and the darkening of the streets and the reduction and screening of shop lights, and the extinction of signs, has led to discussion on the art of correct or incorrect illumination in all parts. Seaside resorts were early ordered to reduce their promenade illuminations by one-half or to shut them right off. The first orders, however, were not considered sufficient on the east coast overlooking the North Sea, for it was found that with reduced lighting general glare was still visible 25 miles from the coast. In the London district all sorts of shading and other contrivances have been adopted by shopkeepers and in public conveyances to assist the authorities in their "watching out" for Zeppelins. At the time of writing these conditions continue, and there is good reason to believe that one consequence of the war will be a remodeling of some of the ideas concerning the correct art of illuminating shop-windows and shop and other exteriors.

In the lighting of public thoroughfares the changes have been fairly general throughout the United Kingdom. Developments in the lamp-making world have meant the substitution of half-watt metal filaments for both electric arc and gas lamps. Manchester, already committed to its scheme, carried into effect its idea of using 11-ampere arc lamps for miles of streets, and gas for miles of other streets, but the more general movement has been in the direction of substituting central-suspension fittings with half-watt lamps in place of electric arcs on standards at the curb. London, Poplar, Saint Pancras, Kensington and West Ham are called to mind among other districts where fairly important work has been done. At West Ham, for the lighting of tramway routes, arcs gave way to 200-watt incandescents, one on each pole, or lanterns containing four 100-watt lamps, and 200 gas lamps were converted to 100-candle-power incandescent electrics. Edinburgh may also be mentioned. Recent reports showed that here out of 682 public lamps over 260 had been changed over to half-watts, and others were changing over at the rate of 40 or 50 per week. Here no doubt and in a number of other cities the necessity for dispensing with carbons, of which the war caused a shortage in England, hastened the half-watt change. One of the leading English lamp makers who generally speaks with inside knowledge, suggested a month or two ago that we might be on the verge of still more important advances in the lamp invention field than we had then seen, and he referred to a large-minded arrangement that was in existence between leading makers in England, America and Germany, under which co-operation in research and laboratory experience in lamp manufacture was proceeding.

There has been notable progress in the introduction of electricity, especially for lighting service, in public workhouses, asylums, and infirmaries, hospitals, sanatoria and schools. It is remarkable that electrical illumination has been avoided so long in many of these places. From a remote lunatic asylum in Ireland comes a report that with its new electric light plant it finds that the cost per light is $2.26 against $4.52 for gas, for a given period, that with electricity it has three times as much light, and that there is a coolness of atmosphere in summer and an absence of blackening of walls. Electrical men of course know all about such things, but those responsible for our public institutions still seem in many places to require bombarding with publicity powder and shot of this kind to show them the error of their ways in spending the public funds.

There is now available an interesting collection of data gained from practical experience regarding the electric lighting of very small and moderately small residences. References have been made in these pages on several occasions during the past year to the achievements in certain districts. The Middleton Council has been experimenting with the supply to thirty garden village houses at a fixed charge of $6.24 per year. Wednesburg has had particular success with its cottage lighting scheme, 250 small consumers being connected up in 18 months. Barnes, Finchley and Southport may also be named, while at Wimbledon the fixed-price light system applied to residential property by co-operation with the municipality brought on in the first 18 months as many as 1,000 consumers with 3,590 lamps.

As will be gathered from a reference earlier in this article the times have not been propitious for electric sign work. Until the war broke out there was undoubted and gratifying advance proceeding, but further progress cannot be substantial under war conditions. Perhaps the leading piece of electric sign work during the year in London was a fairly large (for us) Franco-British sign erected for the London *Evening News*. It has 900 lamps, the surrounding frame being

green and illuminated with real green glass metal-filament lamps. By means of special mechanism changes of time were announced every minute. This sign is said to be the largest in London.

To the progress of electric driving in industrial works there is practically no obstacle. Some industries adversely affected by the war are probably holding back from changes, but taking the year as a whole and considering the entire industrial community progress has been gratifying. The power demands for works in some districts where war requirements have created unparalleled activity, are likely to reach a record figure, for motors have been for many weeks running practically continuously day and night. The reduced street and exterior lighting (even in some of those places well away from the Straits of Dover and the East Coast), will not materially affect the electricity output where these heavy calls for power are experienced. Manchester Corporation is getting down to its scheme for a new 90,000 to 100,000-kilowatt power station, having brought the existing works up to its full capacity of 55,000 kilowatts by the installation of the largest turbine set so far in England (15,000 kilowatts Zoelly impulse-type turbine, Siemens alternator). Glasgow Corporation is proceeding with the work on its new power station at Dalmarnock, the first section of which will have one 15,000-kilowatt and two 10,000-kilowatt turbine sets. Several electricity supply authorities have been inconvenienced by the fact that plant ordered from Continental works cannot be obtained though in ship or on wharf ready to come across the North Sea.

A very fine piece of dock equipment work was started up by King George at Hull. It is practically throughout an electrical dock and particulars have already appeared in these pages. The Yorkshire Electric Power Company has installed a second 3,000-kilowatt turbine in its Barugh waste-heat station. Further schemes have been undertaken in northeast England for waste-heat generating stations. Extensions of plant have been taking place at most of the leading electric supply systems throughout the country.

In London the electric supply question continues to be the one great matter for companies, municipalities and the London County Council. As a result of much discussion of expert technical and financial reports during the year applications have been filed asking Parliament to appoint a London electricity authority for purposes already detailed here. But it seems improbable that the matter can advance yet awhile. In addition to the war there is a most strenuous opposition from the municipal authorities. The outlook is most uncertain.

The complex nature of the problem of concentrating production and standardizing distribution, which amalgamation is considered likely to bring about, will be obvious from the following particulars of systems in use in London in 1913, as reported upon by Merz and McLellan, experts in the exhaustive study of the matter lately prepared by them:

	Central Area	Greater London
Number of generating stations	41	70
Number of authorities	39	70
Average size of stations	7,646 kw.	5,285 kw.
Average size of units	785 kw.	632 kw.
Number of types or systems of generation	31	49
Number of frequencies	8	10
Number of voltages:		
Generation	20	32
Distribution	21	24
Number of methods of charging and prices	over 50	over 70

Electricity continues to make progress in connection with coal-getting, and the latest statistics available show that the aggregate capacity of electrical equipment and plant in 1,472 mines in the United Kingdom, for winding, ventilation, coal-washing and screening, pumping, portable machinery and all other purposes, is 628,098 electrical horsepower. Coal-cutting machinery is represented by 1,307 electrically driven machines responsible for fourteen and one-quarter million tons per annum, and by 1,587 compressed air machine producing ten and one-quarter million tons.

The last but two of the surface contact systems has now disappeared, that along the sea-front at Hastings. After seven years it has been superseded by the cars being fitted up on the Tilling-Stevens petrol-electric system. Railless electric trolley vehicles have made moderate headway. Bradford has added 28 new cars, but elsewhere advance is not taking place so rapidly as was once expected. The heavy traffic in London owing to the metropolis being the great refuge and center in these war days has been a good thing for the London County Council Tramway system, but serious decreases in traffic have occurred in many provincial cities. Liverpool and Manchester have both been engaged considering exhaustive propositions for colossal expenditures to improve the transport facilities of those congested cities, but a halt must be called at present. Railway electrification work is still proceeding on the several great London systems which were mentioned in my article of a year ago, and a certain amount of work has been proceeding on the Lancashire & Yorkshire and North Eastern systems, but some of the factories have also continued to be busy with the Australian railway electrification contracts. The government has placed the first contracts in connection with its London postal tube electric railway. The Bachelet levitated flying train proposal excited a great deal of interest in press and in some aristocratic circles, but when it took the form of a public prospectus inviting subscriptions of capital it failed to attract.

The British Aluminum Company is considerably extending its works at Kinlochleven in Scotland, for the manufacture of carbon electrodes, and for the manufacture of aluminum for supply to its factories in Norway and elsewhere. It is impossible in this article to refer to all the efforts that are being made to manufacture in England the large volume of electrical and allied machinery, apparatus and materials for which considerable dependence has been placed upon Continental works in the past. In lighting carbons, ignition magnetos, electric lamps, ebonite and parts and materials required in many directions, there has been a forced absence of buying from the Continent, and the British determination is everywhere apparent that the future will witness a great change in Anglo-German and Austrian electrical trading relations. The outbreak of war meant the closing down of many German houses in London, and while to a certain extent trade was thus made available for British works, this did not compensate for the cancellation or deferring of contracts which took place nor for the general war effect upon the export markets and their financial ability, nor for the temporary disorganization of shipping. It is confidently felt that when the war is over British electrical industry should be in a stabler and altogether better position than has been possible hitherto, but the reasons cannot be stated now—they have already appeared in this review. The departure of so many thousand skilled electrical workers for the front and for training camps has naturally had an effect upon the position of the manufacturers, and in the case of various classes of industrial employees in the engineering, shipbuilding, glass-making and other trades, as well as in the case of the trained staffs of electric power stations, the government has issued statements justifying such men in sticking to their employment as they can serve the country in that capacity equally as well as in the trenches.

The effects of four months' war upon import and export trade is reflected in the returns for the months ended November 30. Not all the decrease, however is attributable to this cause, as export electrical trade had been weakening previously. I extract the following from the official figures:

Imports of electrical goods and apparatus (not including machinery and uninsulated wire), 11 months, $5,760,000; decrease, $1,399,000.

Imports of machinery, 11 months, $30,801,000; decrease, $2,520,000.

Exports of electrical goods (as above), 11 months, $14,167,000; decrease, $11,125,000.

Exports of machinery, 11 months, $149,395,000; decrease, $20,956,000.

Undoubtedly the decrease in imports has meant a certain amount of additional work for British manufacturers, but the decrease in electrical exports has been large and can only to a comparatively small extent be due to the interruption of shipping to countries in Europe that are at war. The world unrest, and restriction of shipping due to various causes have naturally affected exportation to all outer markets, as well as European.

The writer has not been able to include in this review of a strange year, though busy and progressive in every electrical department it has undoubtedly been, any adequate reference to the great achievements that have occurred in connection with wireless telegraphy and telephony, the general Post Office telegraph and telephone systems, new submarine telegraph and telephone work between England and France and Belgium, and between England and Ireland. The development of the postal telephone system has brought telephone and cable manufacturers some millions of pounds worth of work, and both technically and generally the year has been one of exceptional importance in all phases of telegraphic and telephonic endeavors. The opening of the Marconi trans-Atlantic service between Cefndu, near Carnarvon, and New Jersey, the proceedings in connection with the British Imperial wireless chain; the compulsory wireless equipment of ships; the decision of the government to set up a wireless research laboratory and committee and Marconi's work in wireless telephony over 100 miles with an improved type of transmitter—these are events in the wireless world, and the new work in automatic telephone exchanges; the appointment of a government committee to report on systems of high-speed telegraphy; the laying of a new four-wire telegraph cable about 274 nautical miles long, and weighing 180 pounds copper per millimeter from England to Germany, the arrangements for a submarine telephone cable jointly laid by the English and Dutch governments between Aldeburgh, England and Walcheren, Holland (four-core, coil-loaded type—the longest telephone cable of its kind in the world), these are some of the other outstanding points.

One Year's Progress in Methods of Making and Selling Incandescent Electric Lamps.

By E. J. Edwards and R. E. Scott.

The war in Europe, coming as it did completely without warning so far as most persons engaged in industrial pursuits were concerned, will undoubtedly have a retarding effect on the hitherto rapid progress of the electric lamp industry, unless we in America can, as we hope, develop our own opportunities and resources to a degree that will offset the drag put upon industry due to the war. We refer here not so much to difficulty in obtaining raw materials for incandescent lamps, for in this respect, due to recent discoveries, the American lamp manufacturers are at present comparatively well off. Neither do we refer to the loss of any commercial market for American made lamps, for in that respect we would seem to be gainers rather than losers.

Rather do we refer to the suspension, in the warring countries, of that scientific research which has in the past through friendly co-operation with our own scientists contributed considerably to the present-day incandescent lamp. While the latest great discovery in lamp manufacture, the non-vacuum lamp, is a new-world invention, we do not forget that we are indebted to the old world for many of the discoveries that led up to it. Also we have in mind the fact that during the four years of our own Civil War not a single noteworthy improvement took place in the broad art of lamp-making. But whether or not the disturbed situation in Europe proves to have a restraining influence on future progress in incandescent lamp development, the progress made during the past year has certainly been brilliant. If America can keep up her "gait" of the past two years in this field, the art as a whole will hardly be retarded by the war.

This article relates to the progress made in the manufacture and in the selling of incandescent lamps, particularly during the past year.

Considering the various equipment which comprises the chain of devices used in supplying electric light, there can be but little question but that the most rapid improvement has been made in that link which transforms the energy received on the premises of the customer, into light. The past few years have brought forth increases in efficiency in incandescent lamps so great that now more light per pound of coal is obtained than would have been possible had there been found a way of making all the other links in the chain 100 per cent efficient, but still being compelled to use the old three and one-half and four-watt-per-candle carbon lamps. The curves of Fig. 1 show graphically the increase of efficiency of incandescent lamps. The efficiency given for the various years is taken as the highest efficiency in a commercially available lamp used for general illumination purposes. It is seen that 35 years were required to increase the efficiency 7 times, and then the past year saw an increase from 7 times to 14 times the original value. The progress made within the last year is very properly considered remarkable.

Parallel with the improvement in efficiency there has come a considerable extension in the range of available sizes of units. The lower limit for a given voltage class has remained about the same, but the upper limit has been greatly extended. For example, a year ago the highest candlepower commercially available lamp for 110-volt circuits was about 500. At the present time it is about 1,800. Table 1 shows the present limits of wattage and candlepower for various voltage and current classes.

Marked progress has been made within the past year toward greater uniformity in lamps. There was a time when there would have been a very considerable loss in manufacture had it been necessary to supply lamps for only one value of voltage or only one value of current in a given class of service, because it was not possible to manufacture with sufficient uniformity to insure practically all of the product measuring up to the designed-for requirements. At the present time the refinements in manufacture have brought about a substantially uniform product, and the manufacturers of lamps have now reached the point where they favor the standardization of operating voltages and currents. A high degree of uniformity in lamps tends to bring about greater accuracy in methods of operation. When lamps are known to be uniform in the con-

formance to a carefully designed rating, the user is much more likely to avoid extreme drops in the wiring and to raise his standards of steadiness of supply voltage.

A very great improvement in uniformity has been made in the smaller low-voltage lamps—those generally classed as miniature. It was in this class of lamps that improved uniformity was most needed. It is seen that in the one feature of "cutting length" of filament the inherent degree of accuracy must be about the same as in the higher voltage lamps, if accuracy be expressed in a measure of length, but very much less if expressed in *percentage* of total length. Therefore a five-per-cent voltage variation in a six-volt lamp is as apt to occur as a one-quarter per cent variation in a 120-volt lamp. The chances of supply voltage differing from the nominal or desired value of voltage on a miniature lamp are very great, and if it is necessary to add to this condition a considerable variation in the lamps themselves, there is necessarily great lack of uniformity of performance in service. Therefore, the improvement in uniformity is especially important in the low-voltage lamps.

The progress during the past year is especially notable in that many new lamps adapted to special purposes have been developed. A year ago the only highly concentrated-filament lamp for operation on 110-volt circuits was the 100-watt. During the past year the 250 and 500-watt lamps of high efficiency have been added. Also, a line of lower voltage very highly concentrated lamps for locomotive headlights have appeared. It is possible now to produce satisfactory results in many kinds of projection apparatus where only arc lamps were used previously, with a distinct gain in convenience and adaptability.

Most conspicuous of all features of progress made in incandescent lamp manufacture is the use of inert gas in the bulb. It has long been known that the limit of temperature at which tungsten filaments in vacuum could be operated was determined not by the melting point of the material, but by the high rate of vaporization beyond certain temperatures. Higher efficiencies for the vacuum Mazda lamps have always been obtainable, but only with sacrifice of life. The use of a gas in the bulb made possible greatly increased efficiencies in all the high-current lamps—those which were previously limited in life by bulb blackening rather than filament failure. The gas raises the pressure in the bulb and thereby reduces the rate of vaporization and allows the filament to be operated at higher temperature. The higher temperature means an increased efficiency of light radiation and accounts for the improved efficiency of the lamp. But it should be remembered that the increase in efficiency is not as great as would be the case for a vacuum lamp were it operated at the same higher temperature, for the gas in the bulb robs the filament of heat by conduction and convection. This loss in percentage is large for low-current lamps and small for high-current lamps, which fact accounts for the higher operating efficiencies of the large sizes.

The non-vacuum Mazda lamps, because of their new principle of operation, might be expected to show characteristic differing from the vacuum type, and as a matter of fact they do. The most apparent difference is in the color of the light. The whiter light of the new lamps adapts them especially to store lighting, exterior display lighting and various industrial lighting purposes. The higher actinic value of the light has opened to incandescent lamps the photographic field, both for the lighting of studios and for copying equipment.

The high concentration of the filament allows of better control of light with reflectors and refractors. Desired forms of distribution and sharpness of cut-off of light at desired angles can now be obtained in a degree impossible of attainment with larger light sources. The most notable example of the present possibilities in control of light is the prismatic refractor used in street lighting. Many have erroneously assumed that the fact that the refractor and gas-filled lamp were developed simultaneously was merely accidental. As a matter of fact, the result obtained with the refractor unit were made possible by the small size of the light source in the new lamps.

It should, of course, be understood that while the non-vacuum lamps were placed upon the market during the past year, the research work leading up to their invention took place prior to this.

After all that is said about the more spectacular features of lamp progress, the extension of the range of sizes and the high efficiencies obtainable in the large sizes by a new principle of operation, one is apt to lose sight of the less conspicuous but yet very important progress in increasing the efficiencies of the smaller units. The 1914 report of the Lamp Committee of the National Electric Light Association shows that, for 1913, more than 70 per cent of all Mazda lamps sold were 25, 40 and 60-watt, while all sizes above 60-watt constituted less than eight per cent of the total. The past year has brought an eight-per-cent increase in efficiency in the 25, 40 and 60-watt lamps. It seems safe to say that the improvement in the smaller sizes, though less spectacular than the work done on the large lamps, will result in an even greater total saving to users of electric light.

The past year's advances in the art of *making* lamps have brought about several novel methods of *selling* the newly developed types. On January 1, 1914, the non-vacuum lamps were not even on the market. By January 1, 1915, nearly one million of these had been sold—a truly unprecedented re-

	CLASS	WATTAGE LIMITS	CANDLE-POWER LIMITS
A	1.5 - 19 VOLTS	1 - 108	0.5 - 166
B	20 - 90 VOLTS	3.6 - 250	2 - 357
C	105 - 125 VOLTS	10 - 1000	7 - 1820
D	220 - 250 VOLTS	25 - 500	19 - 500
E	3.5 - 20 AMPS	34 - 500	32 - 1000

TABLE OF LAMP SIZES CORRESPONDING TO WATTAGE AND CANDLE-POWER LIMITS IN ABOVE TABLE

	LOW LIMIT	HIGH LIMIT
A	Flashlight Lamp	6V-108W Loco. Headlight Lamp
B	21V Rear or Speedometer Light	30V-250W Loco. Headlight Lamp
C	Regular 110V-10W Sign Lamp	1000W Multiple Gas-filled Lamp
D	Regular 220-25W Lamp	Regular 220-500W Lamp
E	3.5 a-32 c.p. St. Series Lamp	20 a-1000 c.p. Compensator Lamp

Table I.

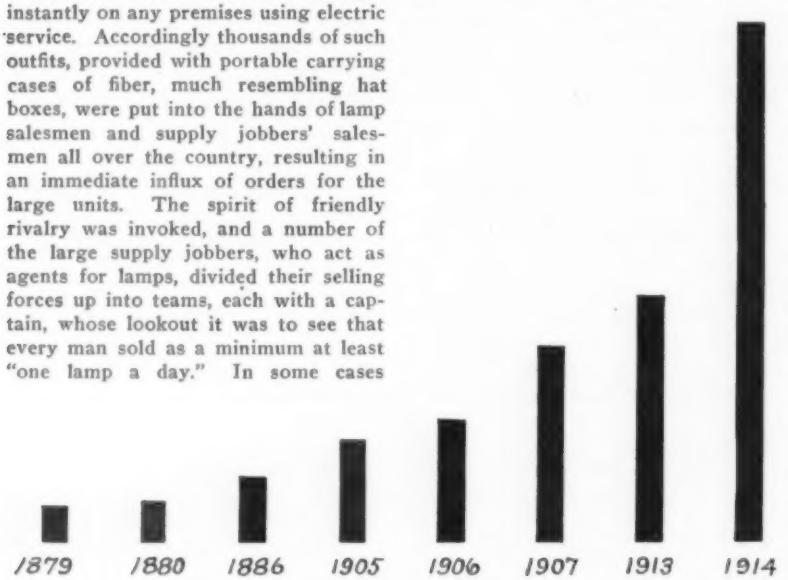
cord. How has it been accomplished? Very largely by the novel commercial methods above referred to. These may be classified into (1) methods of popularizing the non-vacuum multiple lamps; (2) methods of popularizing the non-vacuum series lamps.

(1) **Multiple Lamps.—The 200, 300,** 400, 500, 750 and 1000-watt lamps have been popularized mainly by campaigns of personal demonstration. It was early recognized that the lighting of building fronts offered an enormous market for the 750-watt lamps especially, and that portable oufits consisting of lamp, socket, globe and flexible cord could be used to demonstrate the light instantly on any premises using electric service. Accordingly thousands of such outfits, provided with portable carrying cases of fiber, much resembling hat boxes, were put into the hands of lamp salesmen and supply jobbers' salesmen all over the country, resulting in an immediate influx of orders for the large units. The spirit of friendly rivalry was invoked, and a number of the large supply jobbers, who act as agents for lamps, divided their selling forces up into teams, each with a captain, whose lookout it was to see that every man sold as a minimum at least "one lamp a day." In some cases prizes were offered to the men making the best records over a given period of time. Large space was taken in the electrical trade papers.

All of these aggressive methods worked admirably, and it bespeaks the versatility of those in charge of lamp sales that they recognized the radical difference between the methods necessary to disseminate information about the new large lamps and the older, well established methods of stimulating the market—already approaching saturation—for the smaller sizes.

Central stations and dealers were encouraged to practice their preaching by installing 750-watt or 1,000-watt lamps in front of their own places of business, and they responded on a large scale to the suggestion. Special metal signs were developed to be suspended from the units, calling the attention of the public to their advantages. Special "nicknames," such as "Frontlite," were coined for the more popular units, including fixture, holder, globe, socket and lamp.

A novel and very convenient method of demonstrating the quality and intensity of light from the non-vacuum Mazda lamps was produced by making up 200-watt lamps in a much smaller bulb than that furnished commercially. These small bulbs could readily be slipped into the salesman's coat pocket. Internally, the lamps were identical in construction with the standard 200-watt lamps, and when the salesman inserted his demonstrating lamp in the customer's socket, remarking "Here's a little chip off the sun," the bursting forth of 250 candlepower from so small a source was very striking, and generally resulted in a sale wherever there was a latent demand for the lamps. The extremely small bulb would of course be impractical commercially, as it would greatly shorten the life of the lamp, a fact fully explained on the labels of the pocket demonstraters.



Increase in Efficiency of Incandescent Lamps.

(2) **Series Lamps.**—Direct demonstration methods have also been found highly successful in introducing incandescent street-series units consisting of the new prismatic glass refractor and gas-filled series lamp. Sample refractor units with 400-candlepower lamps have been sent on trial to many central stations and the latter have been invited, either by correspondence or by a sales engineer in personal interview, to place the samples for a few nights in the series circuit with alternating-current inclosed arc lamps, and to note the increase in effective illumination. As a rule, the demonstration is witnessed also by a delegation from the city council, and when these gentlemen learn that the lighting company proposes to give them such a noticeable improvement in the street lighting with no increase in the light bill, an authorizing ordinance specifying the later equipment usually follows in short order.

A word should be said about two fields that the new incandescent lamps are helping to open up; viz., "flood-lighting," and studio photography at night. By flood-lighting is meant the use of projected light for general illumination or display purposes, as for example in the case of the Dime Savings Bank, Detroit, last July; the Baltimore City Hall Dome, in September; and the tower of the Woolworth Building, New York City, at the present time. Flood-lighting has also proved very successful for theater stage effects. Combining as they do high luminous efficiency with freedom from the necessity for constant attendance, the new lamps are peculiarly suited for flood-lighting. The larger sizes should, however, be burned in the vertical position, tip downwards, and the projector should provide ample ventilation so that the heat will not soften the bulb. In other words, the installation should be designed not by an amateur, but by an experienced engineer who has made a study of existing installations, if the best results are to be obtained.

For stereopticon work, the 250-watt concentrated-filament non-vacuum lamp is becoming very popular. The 100-watt vacuum lamp in many cases did not give light enough for this class of service.

For picture-taking at night, the 1,000-watt lamp, furnished in a "natural" blue bulb, and provided with an adjustable stand and adjustable diffusing screens, is coming into general use among photographers, providing as it does an agreeable light of high actinic value. A prominent photographer serving an exclusive clientele in Washington, D. C., issued an announcement not long ago to the effect that, having installed the Mazda "Photolite" system (as the blue lamp with its accessories is called), he is now making appointments for sittings in the evening as well as by day. Many other photographers all over the country have taken similar action with successful results.

A survey of the statistical information available, as regards the number of incandescent lamps consumed in this country annually, leads us to the conclusion that the grand total, including both large and miniature, approximates the enormous figure of 125,000,000. In 1913, 46 per cent of these were regular Mazda (excluding miniature Mazda) lamps. In 1914 the percentage of regular Mazda lamps had increased to nearly 60 per cent.

Electrical Securities and the Central-Station Industry in 1914—Prospects for 1915.

By J. M. C. Hampson.

There was only one big failure among central-station controlling systems during the last five months of 1914 and it was a new combination, although a good many large companies in common with some 200 other corporations throughout the country passed their dividends. It was expected that the confusion in financial affairs resultant from the war in Europe would lead to more disasters to almost all industries, but there was an exhibition of fine stability and well sustained earnings as far as public-utility companies were concerned.

The most notable fact connected with the central-station industry was the wave of economy and retrenchment that swept over the country. The large central-station systems seemed determined to make $75,000 do where $300,000 had seemed none too much for the needs of the purchasing departments before. Side by side with this went an absolute stoppage of the flow of capital into the industry. New central-station systems and additions to, and developments in, existing ones came to a halt From the period beginning at the end of July and ending with the close of the year there were possibly but two flotations made, that is, bids for capital by the issuance of short-term notes or like securities. Yet there was plenty of capital and plenty of contemplated building, also additions to equipment and divers electrical projects in all parts of the country. Things were, however, suspended in mid-air so to say.

Curtailment of purchasing by central stations and central-station systems brought about a corresponding curtailment in the business of the manufacturing side of the industry and a shrinkage in gross and net earnings. But public-utility companies as a whole not only maintained their earnings, but they have also continued their normal increases. Their stability has been most impressive and there is no other group of companies that could have shown the same earning power in the critical months of last year.

Taking one representative group of central-station systems it appears that for the 11 months ending November 30 last, the gain in net earnings was seven per cent. In October and November the gain over the same months in 1913 was as high as 10 per cent, and the same ratio and even an improvement in it was continued throughout December. It is quite clear then, without giving more such illustrations, that war conditions have not seriously impaired the net earnings of electric companies although the gain in gross was not, on the whole, so satisfactory for last year. November and December last, however, showed particularly good increases in business over the same months in 1913.

As has been noted, one of the big features of the last six months of 1914 was the extraordinary effort made by the big central-station systems to reduce expenses and economize and save in every direction. All work on plant extensions and equipment was stopped and all manner of minor expenses were checked and restricted. They were wise precautions, adopted in order that dividends and interest might be paid as regularly as ever. It was not at all certain as to how the public might act in the confusion and agitation regarding financial conditions abroad and the position of the United States in relation thereto. A general drop in business, continued laying off and discharge of men in other lines of industry, might mean a most serious reduction in revenue even to the most stably managed utility corporation. As a matter of fact, earnings were in most cases sustained. And looking at the future it is certain that increased demand for power brought about by the probable boom in business during 1915, more electric signs to advertise it and freer use of light will, with the removal of the save-at-any-cost attitude of the general public, produce still greater increases in revenue in the months to come.

Now as to the investment side of the situation, opinion is entirely optimistic. When in the middle of November unrestricted trading in bonds was opened, followed by the opening of the Chicago Stock Exchange, then of the New York bond market and finally of the New York Stock Exchange, it was made very evident that that section of the public which had anticipated heavy European liquidation was decidedly disappointed. On the contrary, trading and prices in November and December indicated a fresh start on the up-grade. Prices at the opening of each exchange ruled several points higher than the close July 30 last. Moreover it became very clear that the large amount of stocks, and particularly bonds, remaining in Europe are in conservative and capable hands. This being the situation, Europe is more inclined to buy than to sell.

These facts then must have clearly demonstrated to the public the stability of the electrical industry in all its branches and of its securities, using the term in the broad sense, in fair and foul weather. The same intelligence and farseeing sagacity that has given it such enormous development in the past 15 years, was once more displayed in the ability to hold back, cut down expenses and draw in when necessary. There were, it is true, some setbacks last year, but the central-station industry compared favorably, more than favorably with any other section of the business world.

It has been stated that public utility securities are less affected by depression than any other type of investment. It is interesting to note the effect of a tremendous crisis such as has confronted the world since July last, upon companies of such a kind serving communities in every section of the United States. To be specific then seven companies supplying gas, electric light, and traction service in New York, New Hampshire, Vermont, Mississippi, Oklahoma, Utah and Idaho have been chosen. These companies are so scattered that they should accurately reflect conditions, as they are situated in every corner of the United States.

The combined gross earnings of the seven companies as reported for the months of August and September in 1912, 1913, 1914 have been taken. The combined figures appear as follows:

1912—$220,954.21.
1913—$248,699.69.
1914—$263,576.11.

The months of August and September marked the beginning of the European war, which caused many industries in this country to suspend forthwith and over 200 companies to pass their dividends, while railway earnings immediately reflected the falling off in freight traffic caused by curtailment in almost all lines of business. The figures given above show an actual increase in the earnings of the combined utility companies during this critical period as compared with the same period last

year. The increase of 1914 over 1913 is, to be sure, not so large as the gain of 1913 over 1912, but the fact that there is an actual increase goes far to prove to the investor in public-utility bonds the strength of his or her convictions in the sound position of this class of security.

Furthermore, it may be added that in the future to meet the increased demand on the part of the public for public-utility services, it is estimated that one billion two hundred million dollars of new capital per year will be required for many years to come, or four million dollars for every working day.

The future as time goes by can only demonstrate more certainly that there is no earthly reason for people who have money to invest to pause and wonder where to put it, for America's great public-utility field presents the greatest opportunity in all the wide world.

Typical Standard in Portland.

Soldiers and Sailors' Monument.

Special Street and Monument Lighting in Portland.

One of the finest street-lighting installations in the country is that of Congress and Middle Streets in Portland, Maine. Here are 325 clusters of four 100-watt tungsten lamps, installed on iron standards used also as trolley poles by the Portland Railroad Company, the local traction line. This company is closely affiliated with the Cumberland County Power & Light Company, which furnishes current for street lighting.

The poles are 25 feet in height, and the lamps are 15 feet above the sidewalk. The spread of the opposite lamps of the groups is 59 inches, and the incandescent units are inclosed in 12-inch alabaster balls. The posts average about 110 feet apart along both the opposite sidewalks. The total length of streets thus lighted is about 2.3 miles.

New installations of the same type are being made from time to time to replace arc lamps and series incandescents.

The lighting of public monuments is admirably exemplified in Portland by the electric illumination provided about the Soldiers' and Sailors' monument in Congress Square. Four iron standards, and similar in general design to the standards just described, each 25 feet high, stand one at each corner of the base of the statue and carry on top a 500-watt Mazda lamp inclosed in a 16-inch alabaster globe supported on eight metal fingers with openings between to admit sufficient air for ventilation.

Ten feet below, at a height of 15 feet above the ground, four 250-watt tungsten lamps are carried on a four-arm bracket with three-feet spacing between the lamps, which are inclosed in 12-inch balls.

The special fixtures for this installation were designed by the city electrician of Portland.

Bell Employees to Become Stockholders.

The American Telephone and Telegraph Company announces that arrangements have been made by which employees of the Bell System who have been two years or more in the service and who so desire may purchase stock of the company for $110 per share on easy terms of payment.

No employee can purchase more than one share for each $300 of annual wages he receives nor more than ten shares whatever his wages.

The terms of payment will be $2.00 per share per month beginning with March, 1915, and the quarterly dividends paid on the stock will go towards paying for it after deducting interest at four per cent per annum on the unpaid balances.

The American company has paid eight per cent dividends for seven years and it is calculated that dividends at this rate and the $2.00 per share per month payments by employees will pay for the stock in full by November, 1918. Any employee who so desires can, after March 1, 1917, but not before, pay in the balance on his stock and receive his stock certificate.

Should an employee leave the service or die before his stock is fully paid for, the amount he has paid in plus the accumulated dividends (less four per cent interest) will be paid back.

The American Telephone and Telegraph Company is the parent company of the Bell Telephone System which operates or connects with eight and a half million telephone stations, throughout the United States.

It has about 60,000 stockholders and 160,000 employees. Its issued capital stock is nearly $350,000,000, and is quoted on the stock exchanges at about $118 per share.

Electrical Engineering Problems.

By R. G. Hudson and W. V. Lyon.

DIRECT CURRENTS.

Problem 17.

Two short-shunt, compound generators are connected in parallel as shown in Fig 17. The resistances of the shunt and series fields respectively of the two machines are as follows:

	A	B
Shunt field	50 ohms	20 ohms
Series field	0.01 ohm	0.003 ohm

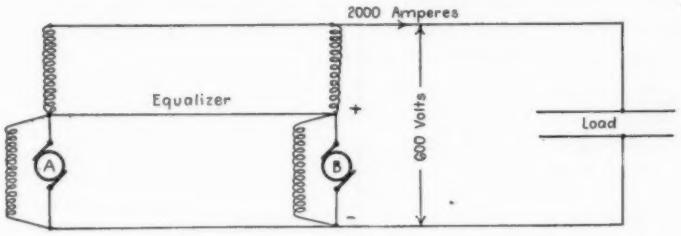


Fig. 17.

The difference of potential between the positive and negative busbars is 600 volts and the total current supplied by the two machines is 2,000 amperes. Neglecting the resistances of the busbars and equalizer, if the armature current of machine B is three times that of machine A, find (a) the current in the equalizer and its direction; (b) the armature current of A, and (c) the armature current of B. Find (d) the respective armature currents in A and B when the equalizer current is zero and the voltage and current supplied to the load are the same as shown in Fig. 17.

SOLUTION OF PROBLEM 17.

The directions of the various currents will be as shown in Fig. 18 except that the direction of the equalizer current is assumed as suggested in Problem 3.

The joint resistance of the two series coils is given by [8]

$R=0.01\times0.003/0.013=0.00231$ ohm.

The series coil currents (I_1) and (I_2) may then be found by [11]

$I_1=2{,}000\times0.00231/0.01=462$ amperes.

$I_2=2{,}000\times0.00231/0.003=1538$ amperes.

The voltage between brushes of A (V_A) and B (V_B) is given by [5]

$V_B=600+1{,}538\times0.003=604.6$ volts.

$V_A=600+462\times0.01=604.6$ volts.

The shunt field currents (I_3) and (I_4) may then be found by [6]

$I_3=604.6/50=12.1$ amperes.

$I_4=604.6/20=30.2$ amperes.

Assuming the equalizer current (I_E) to flow to the right as shown in Fig. 18, the following junction equations (see [13]) may be written;

(1) $I_A=12.1+462+I_E$
$=474.1+I_E$

(2) $I_B=30.2+1{,}538-I_E$
$=1{,}568-I_E$

Answer to Question a.

Substituting for (I_B) in (2) its equivalent ($3I_A$) and solving the two equations for (I_E) we have $I_E=+36.5$ amperes.

The positive sign indicates that the direction assumed in Fig. 18 is correct.

Answer to Question b.

Substituting the above value of (I_E) in (1),

$I_A=474.1+36.5=510.6$ amperes.

Answer to Question c.

Since $I_B=3I_A$,

$I_B=3\times510.6=1{,}532$ amperes.

Answer to Question d.

Rewriting the two simultaneous equations as first stated,

$I_A=12.1+462+I_E$

$I_B=30.2+1{,}538-I_E$

When $I_E=0$,

$I_A=12.1+462=474.1$ amperes.

$I_B=30.2+1{,}538=1{,}568$ amperes.

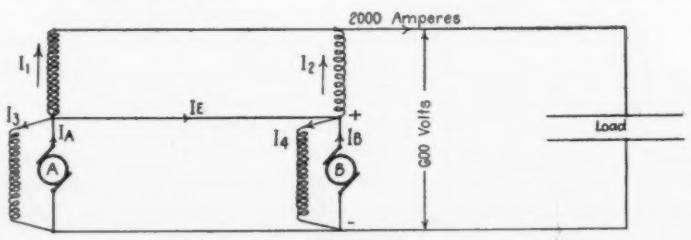


Fig. 18.

It will be observed in the answer to **Question d** that the equalizer current is zero when the armature current of each machine equals the sum of its shunt field and series field currents. The condition of zero equalizer current may then be realized in practice by adjusting the three currents until the conditions stated above are fulfilled. The series-field-circuit current may be changed by changing the resistance of the series-coil shunt. The shunt-field current may be changed slightly by changing the resistance of the shunt field rheostat. It should be noted that in both of these methods the armature current is also changed, since any variation in the series-field current or shunt-field current affects the armature voltage and consequently the armature current as well. The armature current may also be varied by changing the rotational speed of the armature but in practice the adjustment is usually made by varying the resistances of the shunt-field rheostats of the two machines.

The operation of two or more compound generators in parallel without the equalizer connection shown in Fig. 18 is very unstable. Without such a connection, if the speed of A for some reason should decrease slightly its armature voltage and armature current would decrease. With no equalizer connection a decrease in the armature current of A would cause a decrease in the current flowing in its series winding. This would decrease the flux due to the series field winding and thereby cause a further decrease of armature voltage. The armature voltage of A may decrease in this manner until it is exceeded by the terminal voltage of the two machines. The current in the series winding would then reverse and A would be operated as a differential motor. It should be observed, however, that in the meantime the whole load has been transferred to B and before A could reach the condition of motor operation the overload on B would open its circuit-breakers or disrupt its fuses disconnecting B from the circuit. The entire load would then be transferred to A which would be disconnected in the same

ALTERNATING CURRENTS.

Problem 67.

Two 500-kilovolt-ampere, 13,200:2,000-volt transformers of different design are connected to receive power from the same 13,200-volt circuit. On the low-tension side, however, they supply power to two independent circuits. The first transformer takes full-load current at 96 per cent power-factor from the high-tension circuit and the second takes full-load current at 82 per cent power-factor.

With the measuring instruments placed on the high-tension side, the short-circuit data for these transformers are:

	Amperes	Volts	Watts
No. 1	38	1,100	4,640
No. 2	38	414	3,390

(*a*) What is the low-tension voltage of each transformer? (*b*) What is the current in the high-tension circuit? If the transformers are connected in parallel on the low-tension side the second one becomes very hot. (*c*) Assuming that the high-tension current as found in (*b*) is unchanged, what is the current in each transformer when this connection is made? (*d*) Compare the copper losses in the transformers before and after the low-tension windings are connected in parallel.

manner as *B* and all power to the load would be cut off.

With an equalizer connection as shown in Fig. 18 the operation is rendered stable, since the currents in the series field windings divide inversely as their resistances and it is impossible for the current in either winding to reverse. Two such machines operated in parallel will divide the load in proportion to their capacities if (1) their terminal voltages are the same at the same percentage of their full-load rating, i.e., their external characteristics are of the same shape and overlap, and (2) the resistances of the series field circuits (inclusive of series field shunts) are inversely proportional to their capacities. Under these conditions the respective loads on the two machines will be divided in proportion to their capacities at all loads and the equalizer current will always be zero.

SOLUTION OF PROBLEM 67.

Answer to Question a.

The method of calculating the regulation—that is, the relation between the high- and low-tension voltages—was explained in Problem 65. From the short-circuit data the equivalent constants, Z_1, R_1 and X_1 of the first transformer are:

$$Z_1=1{,}110/38$$
$$=29.2 \text{ ohms.}$$
$$R_1=4.640/38^2$$
$$=3.21 \text{ ohms.}$$
$$X_1=\sqrt{29.2^2-3.21^2}$$
$$=29.0 \text{ ohms.}$$

Likewise the equivalent constants of the second transformer are

$$Z_2=414/38$$
$$=10.9 \text{ ohms.}$$
$$R_2=3{,}390/38^2$$
$$=2.35 \text{ ohms.}$$
$$X_2=\sqrt{10.9^2-2.35^2}$$
$$=10.6 \text{ ohms.}$$

Since the instruments were connected in the high-tension side during the short-circuit test the equivalent constants as calculated are all referred to the high-tension side. The vector diagram is given in Fig. 17a. The current in the high-tension side is drawn along the horizontal axis. The horizontal and vertical components of the high-tension voltage are respectively

$$V_h=13{,}200\times0.96$$
$$=12{,}670$$
$$V_v=13{,}200\sqrt{1-0.96^2}$$
$$=13{,}200\times0.278$$
$$=3{,}670.$$

The transformers are receiving full-load current on the high-tension side, and are thus, of course, delivering full-load current on the low-tension side. The full-load high-tension current is found by dividing the rated kilovolt-ampere capacity by the rated kilovolts. A capacity rating in kilowatts always implies that the full-load current is to be calculated on the assumption of unit power-factor.

The full-load high-tension current is

$$I_1=500/13.2$$
$$=37.9 \text{ amperes.}$$

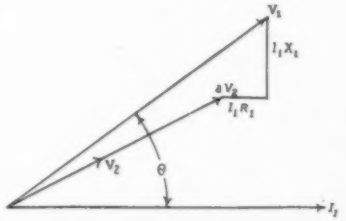


Fig. 17a.

By [22a] $I_1R_1=37.9\times3.21$
$=122$ volts.

By [23a] $I_1X_1=37.9\times29.0$
$=1{,}100$ volts.

The horizontal and vertical components of the low-tension voltage referred to the high-tension side, viz., aV_2, are

By [19a] $(aV_2)_h=12{,}670-122$
$=12{,}548$ volts.
$(aV_2)_v=3{,}670-1{,}100$
$=2{,}570$ volts.

By [20a] $aV_2=12{,}800$ volts.

The ratio of transformation, a, is

$$13{,}200/2{,}200=6$$

Therefore $V_2=12{,}800/6$
$=2{,}133$ volts.

This is the low-tension voltage of the first transformer. The low-tension voltage of the other transformer is found in a similar way.

The horizontal and vertical components of the high-tension voltage in this case are

$$V_h=13{,}200\times0.82$$
$$=10{,}820 \text{ volts.}$$
$$V_v=13{,}200\times0.571$$
$$=7{,}540 \text{ volts.}$$

By [22a] $I_2R_2=37.9\times2.35$
$=89$ volts.

By [23a] $I_2X_2=37.9\times10.6$
$=402$ volts.

By [19a] $(aV_2)_h=10{,}820-89$
$=10{,}731$ volts.
$(aV_2)_v=7{,}540-402$
$=7{,}138$ volts.

By [20a] $aV_2=12{,}880$ volts.
$V_2=2{,}147$ volts.

This is the low-tension voltage of the second transformer. It is a little greater than that of the first. This is due to the

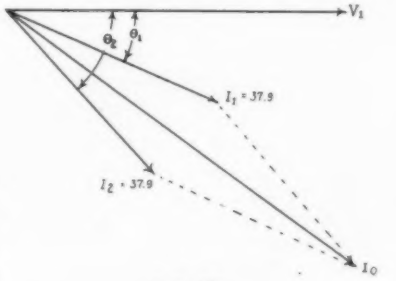


Fig. 18a.

fact that the equivalent impedance is only about one-third as great as for the first.

Answer to Question b.

The method of adding alternating currents was described in Problem 53. The vector diagram is given in Fig. 18a. In this case take the high-tension voltage along the horizontal axis. The horizontal and vertical components of I_1 are

$$(I_1)_h=37.9\times0.96$$
$$=36.4 \text{ amperes.}$$
$$(I_1)_v=37.9\times0.278$$
$$=10.5 \text{ amperes.}$$

The horizontal and vertical components of I_2 are

$$(I_2)_h=37.9\times0.82$$
$$=31.1 \text{ amperes.}$$
$$(I_2)_v=37.9\times0.571$$
$$=21.6 \text{ amperes.}$$

The horizontal and vertical components of the total current on the high-tension side are

DIRECT CURRENTS.

Problem 18.

The dimensions of the magnetic circuit of the 100-kilowatt, 230-volt four-pole dynamo shown in Fig. 19 are as follows: Mean lengths of sections of magnetic circuit—each field yoke (*BCD*), 29 inches; each field core and pole shoe, (*AB* or *DE*), 8 inches; each armature path (*FG*), 16 inches; each air-gap (*EF* or *GA*), 0.25 inch. Mean cross-sectional areas (perpendicular to magnetic flux)—field yoke, 0.5 square foot; field core, 1.1 square feet; air-gap, 1.3 square feet; armature (each magnetic path), 0.35 square foot. The field yoke, field core and pole shoes are made of cast steel and the armature is made of annealed sheet-steel punchings. The magnetization curves for these materials are given in Fig. 20. (*a*) Assuming that the air-gap flux equals 85 per cent of the field-core flux, find the number of ampere-turns per pole required to produce a flux density of 60,000 lines per square inch in the air-gap. (*b*) Assuming that the machine is to be operated as a shunt generator with a shunt-field loss of two per cent of the output, that 25 per cent of the shunt-field drop is to be in the shunt-field rheostat and that the mean length of a shunt-field turn is 5 feet, find the proper size of shunt-field wire which will satisfy the conditions of question *a*.

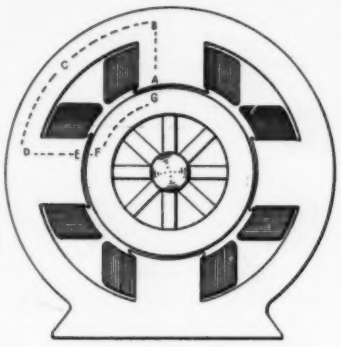


Fig. 19.

This problem illustrates the principles involved in the construction of the magnetic circuit of a dynamo.

ALTERNATING CURRENTS.

Problem 68.

A three-phase, 60-cycle alternating-current generator is rated to deliver 5,000 kilovolt-amperes at 6,600 volts. The armature windings are connected in star and the field structure has 30 poles. The average resistance of the armature winding measured between any two terminals by direct current is 0.084 ohm at 25 degrees centigrade. The ratio of effective resistance to the measured resistance at this temperature is 1.55. The open-circuit and short-circuit characteristics and the saturation curve for zero power-factor are given by the following test data:

Abscissas	Ordinates		
Field Current	Open-Circuit Terminal Voltage	Short-Circuit Armature Current	Terminal Voltage, 438 Amperes at Zero Power-factor
64	3070	438	0
100	4800	680	1800
150	6500	1020	4200
200	7400	....	5700
255	7950	....	6600
275	8150	....	6900

(*a*) What is the rated speed? (*b*) What is the full-load armature current? (*c*) If this generator delivers 4,000 kilovolt-amperes at its rated voltage and 82 per cent power-factor, what is its kilowatt output and what is the armature current? (*d*) What is the resistance of the armature winding per phase at 25 degrees centigrade, and at 70 degrees centigrade? (*e*) What is the effective resistance of the armature winding per phase at 25 degrees centigrade, and at 70 degrees centigrade? (*f*) What is the synchronous reactance per phase, calculated by using (1) the short-circuit data and (2) the saturation curve for zero power-factor? (*g*) What is the reaction of the armature for a current of 456 amperes in terms of field current, calculated by using (1) the short-circuit data and (2) the saturation curve for zero power-factor?

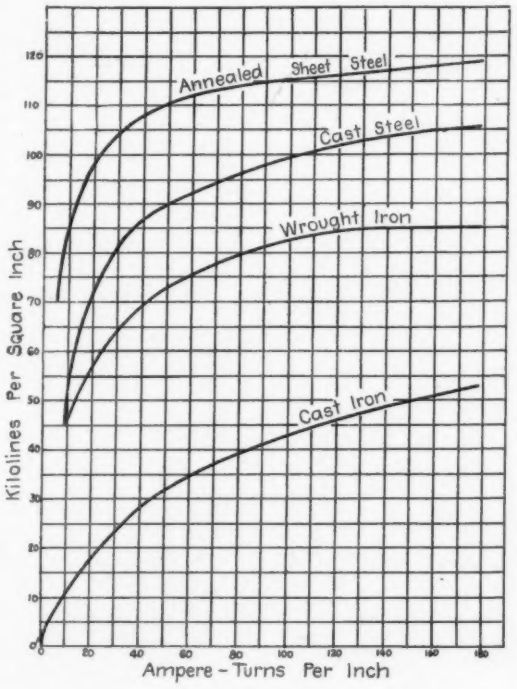


Fig. 20.

This problem illustrates the methods of calculating the constants of an alternating-current generator from test measurements.

Solutions of the above problems and two new problems will be printed in the next issue.

By [26a] $(I_o)_s=36.4+31.1$
$=67.5$ amperes.
$(I_o)_T=10.5+21.6$
$=32.1$ amperes.
By [27a] $I_o=74.7$ amperes.

Notice that this is less than the numerical sum of the currents, which is 75.8.

Answer to Question c.

When transformers which have the same ratio of transformation are connected in parallel on both the high-tension and low-tension sides, the current divides between them in the same way that it would divide between reactors connected in parallel. See Problem 53.

If one side of a transformer is short-circuited the ratio of the current supplied to the impressed voltage is the equivalent admittance. The ratio of the power supplied to the square of the impressed voltage is the equivalent conductance.

By [11a] $Y_1=38/1,110$
$=0.0342$
By [12a] $G_1=4,640/1,110^2$
$=0.00376$
By [13a] $B_1=\sqrt{0.0342^2-0.00376^2}$
$=0.0340$
$Y_2=38/414$
$=0.0918$
$G_2=3,390/414^2$
$=0.0198$
$B_2=\sqrt{0.0918^2-0.0198^2}$
$=0.0897$
By [14a] $G_o=0.00376+0.0198$
$=0.02356$
By [15a] $B_o=0.0340+0.0897$
$=0.1237$
By [13a] $Y_o=0.1259$

The equivalent impedance drop in the transformers is

By [11a] $E=74.7/0.1259$
$=593$ volts.

The current in the first transformer is

By [11a] $I_1=593\times0.0342$
$=20.3$ amperes.

The current in the second transformer is

$I_2=593\times0.0918$
$=54.4$ amperes.

The exact method of calculating the divison of current between transformers is rather long. If an error of not more than about 2 per cent is allowable a much simpler method may be used. The equivalent admittance of a number of transformers in parallel is very nearly equal to the numerical sum of their spearate admittances. That is

$Y_o=Y_1+Y_2+Y_3+\ldots$ approximately.

It is unnecesasry to separate the Y's into their component G's and B's and this effects a considerable saving in computation.

In this case

$Y_o=0.0342+0.0918$
$=0.126$

Notice that this value of Y_o is approximately equal to the value calculated by the exact method. The agreement is not always so close. From this point the calculation follows the previous one.

Answer to Question d.

The copper losses in the transformers before the low-tension sides are connected in parallel are

By [4a] $I_1^2R_1=37.9^2\times3.21$
$=4,630$ watts.
$I_2^2R_2=37.9^2\times2.35$
$=3,380$ watts.

The copper losses in the transformers after the low-tension sides are connected in parallel are

By [4a] $I_1^2R_1=20.3^2\times3.21$
$=1,320$ watts.
$I_2^2R_2=54.4^2\times2.35$
$=6,960$ watts.

The copper loss in the first transformer, which has the higher equivalent impedance volts at full load, is about one-third of its normal value, while the loss in the other with the lower value of equivalent impedance volts is about twice its normal value. This accounts for the excessive heating in this transformer.

When transformers are to be operated in parallel the most important thing is to have the equivalent impedance volts at full load the same for all of them. If this is so they will divide the load satisfactorily.

Sequatchie Transmission Line Completed.

The Tennessee Power Company's Sequatchie Valley transmission line was fully completed about the middle of December. Current is supplied from the power plant at Hale's Bar, of which the Tennessee Power Company is now the largest customer.

Power has been transmitted by the Sequatchie Valley transmission line since the last of August, but only one of the three-phase circuits had been in working order.

College, the little village at which the Brady power plant is connected with the Ocoee-Nashville line, is 36.56 miles distant from the Brady plant at Hale's Bar. The voltage of the connecting line is 120,000, whereas that of the line from the two Ocoee plants to Chattanooga and Knoxville is 60,000 volts.

The two three-phase circuits consist of six heavy aluminum cables. One circuit is of 250,000 circular mils area, and the other 400,000 circular mils. At Hale's Bar the Tennessee River is spanned by a 2,331-foot stretch of steel-core aluminum cable, seven-eighths inch in diameter, suspended between four steel towers sixty feet high. The towers are set on high elevations so the cables are 115 feet above the water. There are 435 galvanized steel towers supporting the double circuit between Hale's Bar and College, the towers being spaced at intervals averaging 453 feet. Tops of the towers are connected with a three-eighths-inch ground wire.

BOOK REVIEW.

"Safety." By William H. Tolman and Leonard B. Kendall. New York: Harper & Brothers. Cloth, 422 pages (5¾x8¾ inches), illustrated. Supplied by the Electrical Review Publishing Company, Inc. for $3.00.

Dr. Tolman is well known as the director of the American Museum of Safety and is well fitted to discuss methods for preventing occupational and other accidents and disease, of which this volume treats. The four parts into which it is divided take up general conditions, danger zones, industrial hygiene and social welfare. One chapter in the second part deals with electricity. This describes safety measures which have been adopted in power houses, gives instruction for resucitation after shock, and points out many precautions which can be taken to increase safety. Most of the chapter is descriptive of the practice of the New York Edison Company. Managers of plants and others interested in promoting greater safety in industry should find this volume helpful. It is stated to be the only comprehensive work on the subject in the English language. Typical examples are given to illustrate the underlying principles of industrial hygiene and safety and to show how their application lowers costs and increases production. The author contends that one-half of industrial accidents are preventable, and gives evidence to demonstrate it. The economic and social aspects of the subject receive due consideration.

Illuminating Engineers Meet in Baltimore.

An informal conference of members of the Illuminating Engineering Society of Baltimore and their friends was held at the Hotel Rennert, Baltimore, Md., on December 16, 1914. The conference was followed by a supper. The program included discussion of illumination from the engineer's standpoint, by Charles L. Reeder, consulting engineer; from the business manager's standpoint, by W. G. Speed; from the railroad standpoint, by A. H. Marin, of the Baltimore and Ohio Railroad; and from the civic standpoint, by W. J. Casey. J. C. McLaughlin, of the Potomac Electric Power Company, Washington, D. C., discussed "Illumination in the Nation's Capital." Douglas Burnett and W. R. Moulton, of the Consolidated Gas, Electric Light and Power Company, who arranged the conference, also made addresses.

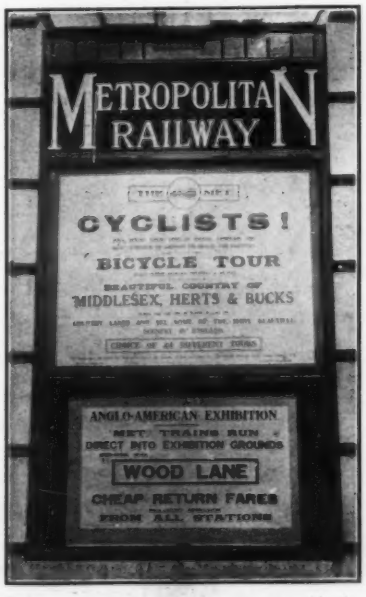
A solder for aluminum which was patented last year consists of 25 per cent of zinc, 50 per cent of tin and 25 per cent of lead.

Unique Electric Signs of London Tube Railways.

An effective mode of advertising is employed by the Metropolitan and Underground Railways in London, England, in the use of transparency signs, displaying either text or illustrations on or inside the glass face of these cabinets. This type of sign is installed at the entrances to several of the stations of these "tube" railways.

Transparency of Underground Railway in London.

In front of the Baker Street Station, in the West End, the sandstone retaining wall of the station approaches from Marylebone Road is utilized as the setting for five of these transparency signs. The cabinets are of sheet metal, with glass fronts, about eight inches deep, and set in the wall so that their face is flush with the external surface of the wall.



Metropolitan Railway Sign.

The front of each cabinet is divided into three sections, each of which is a glass pane set in metal casing and attached to the frame of the cabinet by hinges at the top of each division, with a lock in the lower bar of the casing.

Each cabinet is about 3 feet 9 inches wide, and the three divisions of the glass front are respectively 14, 36 and 27 inches high. The sign advertising the Underground, shown herewith, is painted on the glass, the lettering being of frosted glass with blue outline, and the map of the railway system is in colors, each of the several lines composing the system being drawn in a separate color. Parks are shown in green. A key to the various routes of the Underground Railway is shown in the lower right-hand corner of the central division of the sign.

In the case of the Metropolitan Railway sign, the advertising matter composing the two lower sections consists simply of paper posters, printed on white stock with black ink, the posters being fastened to the wooden framework just inside the doors with thumb tacks. This arrangement permits of a change of poster at intervals, as the season's requirements or special events of interest to the traveling public demand.

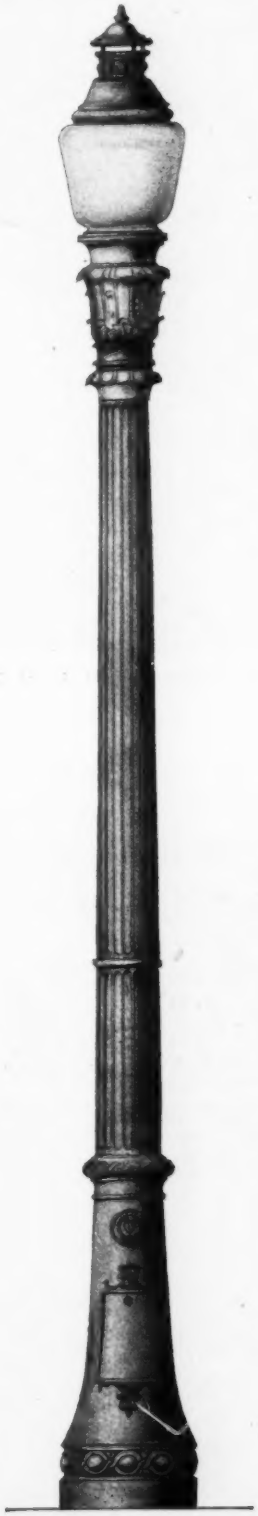
The advertising matter displayed by the Underground Railway sign is, on the other hand, of a fixed character, only the plan of the system being subject to change as extensions may be made in the railway lines. The poetical maxim carried by the lower section, "Underground to Anywhere; Quickest Way, Cheapest Fare," was originated by a boy, in a prize contest, and the sum of £10 (about $50) was paid him by the railway company as a reward for his cleverness.

The interior of the cabinets is studded with incandescent lamps of 32 and 25-watt sizes which are operated on the railway companies' lighting circuits.

Installation of Luminous Arc Lamps in Worcester.

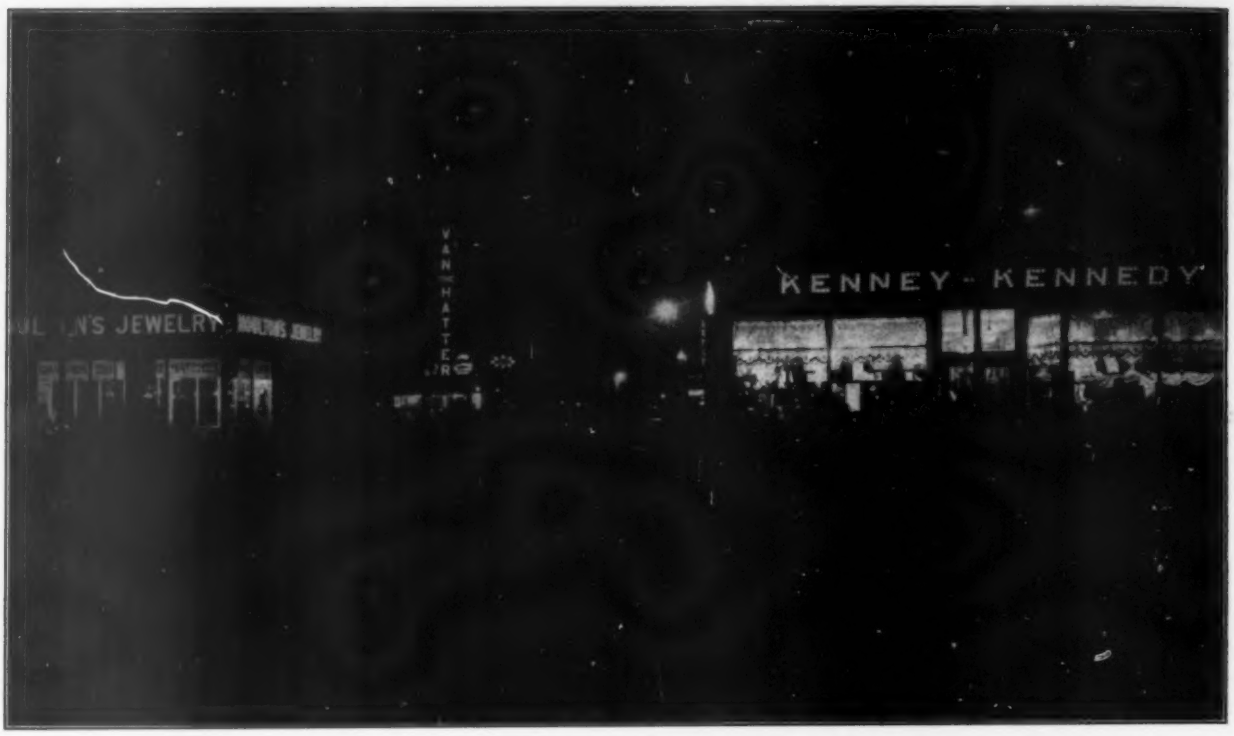
The city of Worcester, Mass., last year adopted and installed a new system of street lighting. The former installation in that city consisted of 400-watt magnetite arc lamps supported on wooden posts and mounted at a height of from 20 to 25 feet above the sidewalk. These lamps were operated at a cost to the city of $80.30 per year of 4,000 lamp-hours.

An agitation for more adequate street lighting in the business district had been conducted for several years and much study had been given to the question of the lighting system which should be adopted. The Merchants Association took an active interest in the matter. The City Council Com-



Lamppost Used in Worcester Street Lighting.

Views of Worcester's New Installation



View Looking Down Mechanic Street From Main Street Before the New Lighting Was Installed—Note the Obscurity of Upper Building Fronts and Compare With Other Views Taken After Turning on the New Units.

View Down Mechanic Street With the New Installation in Use.

of Luminous Arc Street-Lighting Units.

View Looking Down Front Street From the Common.

View Looking North on Main Street.

mittee on Street Lighting finally adopted the recommendations of H. A. Knight, superintendent of street lighting, and decided to install the 6.6-ampere luminous arc lamp made by the General Electric Company.

The standards upon which these lamps are mounted are 14.5 feet high and are set from 100 to 125 feet apart, except at street intersections, where they are placed upon opposite corners. On opposite sides of the street the lamps are staggered, making the distance between lamps upon opposite sides of the street about 60 feet.

All of the lamps will be operated each night from sunset to one o'clock, at which hour every second lamp will be extinguished, the wiring being so arranged that alternate lamps are upon separate circuits. Half of the lamps continue in operation until daybreak and provide ample illumination for this period. The cost of operation is thus reduced.

The installation has been made by the Worcester Electric Light Company, which also maintains the lamps, the city paying $90 per year per lamp for the lamps operating all night and $76 per year per lamp for those which are switched off at one a. m.

The new lamps, to the number of 440, were put in service on June 17 of last year, the inauguration of the new service being the occasion of a celebration by the city. The mayor, George M. Wright, closed the circuit, putting the lamps into operation on that date and a mammoth parade consisting of over 400 motor vehicles with 2,500 occupants was started.

It is expected that the new type of lamp will gradually supersede the older type at present in service in other parts of the city. The accompanying illustrations show typical views of the Worcester streets before and after the new installation was placed in operation.

Automatic Protective Switchgear.

E. B. Wedmore, before a number of meetings of the Institution of Electrical Engineers held in December in London and at provincial branches, considered the general conditions governing the choice and design of automatic protective switchgear for alternating-current systems and described some of the more generally useful devices now available. He said that commercial considerations must ultimately decide the use of any apparatus. For example, on distributing systems employing only a few miles of cable the probability of a fault on a feeder is small, and it is not commercially practicable to employ apparatus requiring special knowledge for its efficient maintenance. Even on such a system, however, a reputation for continuity of supply is a valuable asset.

In such a case, too, probable future developments must be considered. When the system has grown to five times its present dimensions, there are likely to be at least five times as many faults per annum, and the results of individual faults are likely to be far more serious. If these considerations are overlooked when making the initial installation, excessive expenditure or loss will be incurred later on.

The use of protective devices acting selectively to cut out faulty sections will not only ensure continuity of supply, but by enabling faults to be cleared quickly and while only a small current is flowing, will greatly reduce their destructive effects. It is only owing to imperfections in most of the devices offered in the past that their use has not become universal, at any rate on extra-high-tension plants.

On plants rated at more than 20,000 kilowatts, the systematic employment of selective devices throughout is commercially almost a necessity. On much smaller plants it is not sufficiently recognized that the use of selective protective devices often enables economies in the expenditure on cables to be effected, which alone will more than cover the expenditure on the apparatus.

The expenditure on cables is likely to represent one-third to one-half of the total capital expenditure. Owing to heating, the cables are generally run at a lower current density than the economical limit represented by Kelvin's law; yet in order to ensure continuity of supply with indifferent apparatus it has been the practice to duplicate cables extensively, still further reducing the current density and the economy factor. If the selective apparatus employed is of a type independent of the arrangement of the cables, the distribution network can be laid out on the most economical principles, unhampered by the limitations of reverse-current relays and similar apparatus.

Mr. Wedmore roughly classified protective devices under three heads:

(1) Overload devices, or devices which operate when the current exceeds a certain predetermined limit.

(2) Reverse-current devices, or devices which operate when the flow of current at any moment is in the reverse direction to what is normal at that moment.

(3) Leakage devices, or devices which operate when current flows through other than the proper channels.

Some of the devices considered, the author admitted, were by no means simple in design or applications, but he said it would be found that to meet all the ordinary and emergency requirements of electric supply there were now available a series of devices simple in character, well proven in service, and giving a degree of protection hitherto quite unattainable. This series is as follows:

(*a*) For the protection of all closed feeder circuits—the split-conductor system.

(*b*) For the protection of all open-ended feeder circuits, including individual motor circuits, isolated transformers, rotary converters, and the like—the core-balancing system.

(*c*) For the protection of generators and banks of transformers—the circulating-current system.

The advantages of the above combination were summarized as follows:

(1) All the apparatus is simple in character.

(2) All the apparatus is self-contained and completely independent of that on other circuits.

(3) All the apparatus may be adjusted before installation.

(4) No feeder pilot wires are required.

(5) The relays are all simple contact-making devices operating on excess current and are of the same character throughout. In many cases direct-acting trip coils can be substituted.

(6) The relays are not subjected to any forces until they are called upon to operate.

(7) None of the devices are affected by surges.

(8) None of the devices are affected by variations of voltage or of power-factor.

(9) None of the devices are affected by faults occurring outside the sections that they control.

(10) All the devices will deal with faults between phases or to earth on systems with any number of phases.

(11) All the devices are instantaneous in operation.

(12) All the devices will operate at currents comparable with and generally materially less than the normal load current.

(13) If incorrect connections are made this will be discovered on the first trial run.

The Thermophone.

At the meeting of the Royal Society of London on December 3, 1914, the thermophone was described by M. De Lange. This is a form of telephone receiver in which no diaphragm or electromagnet is used. A very fine wire is used, and the sound vibrations are set up by the expansion and contraction of the wire under the influence of the heat generated.

Commercial Practice
Management, Rates, New Business

Prosperity Advertising by Central Stations.

It is generally realized by the business men of the country that extreme measures will have to be adopted to regain the faith of the public at large in the prosperity of the country during the coming year. Many of the larger business interests have already carried on extensive publicity campaigns in the interest of prosperity and the new year will undoubtedly witness more of this class of advertising. Electrical interests have joined in the movement to restore confidence in business conditions and central-station companies have considered this class of advertising as part of their public policy campaigns.

The accompanying illustration shows an advertisement used by all of the Byllesby companies on or about January 1, 1915. The text is as well worth emulation as the idea of the advertisement itself.

Prosperity in 1915 Depends Upon Faith in Our Country

¶ Our Nation is being penalized by a crisis of European methods and ideals.

¶ We cannot escape entirely the bitter fruits of a war founded in governmental systems where Monarchy, Paternalism, Public Ownership and Autocracy go hand in hand

¶ Now as never before we have opportunity to compare American ideals and methods with those practiced in Europe and to measure what American systems and institutions have gained for humanity

¶ Probably we will learn more and more each day of the coming year to appreciate "all we have and are," to regard our citizenship in a more precious light, to see our problems more clearly, more tolerantly.

The war has made material progress difficult throughout the United States. It has added to the obstacles of financing constructive effort. It has enforced economies upon the large and small, has laid on the shelf plans for many desirable things.

Prosperity in this country during the coming year demands above everything else faith in our Republic and faith between man and man. It cannot be had in suspicion and distrust.

If this military calamity teaches us a deeper and more useful patriotism; if it serves to advance understanding among us of one another's rights and wrongs; if it removes prejudice and strikes down distrust — then this war will not be without benefit to the citizens of the United States.

We hope for prosperity the coming year. To have it will require hard work, courage and faith in ourselves.

(Name of Company)
(Name of Manager)

Advertisement That Is Being Used by a Syndicate of Utility Companies.

Service for Minnesota Towns.

The village of Lakeville, Minn., was furnished electric service for the first time December 12, being connected by the Faribault division of the Consumers Power Company. Farmington, Minn., will also be served with Consumers Power Company service under a contract wholesaling current to a private company at Farmington. The local generating plant will be shut down.

Contract-Order Routine in Louisville.

In the ordinary course of business it takes ten minutes for an application made at headquarters of the Louisville, Ky., Gas & Electric Company to make the rounds of the various offices and emerge from the work-order department in the form of instructions to the distribution division to get busy. It not only is possible, but frequently has happened in the last several weeks that a man has applied for an original connection at his home as late as 10:30 o'clock in the morning and has read his evening paper by light furnished as a result of his application on that same night.

All this is one of the first results obtained by the company through its organization of department heads and minor executives, having followed immediately the first meeting at which the subject of "Efficient Service Connections" was considered. The idea of the meetings, which were suggested by Robert Montgomery, manager of the commercial department, is to promote general efficiency.

"Either we must have been pretty slow before or we are mighty fast now," said Mr. Montgomery, discussing the gain, "and we thought we were making good time."

It was done by the simple expedient of eliminating some red tape and readjusting the old system of making entries in the books. Instead of making the rounds of all the departments every application had previously to pass through applications for service now are censored only by those departments which must see them before connections are made. The need for haste is over, for there is plenty of time to get the rest of the entries made in the company's books. The system now in vogue can best be explained by the following extract from a paper read at the first meeting of the employees' organization:

"The employee who takes the contract from the customer starts the machinery necessary to systematically, quickly and correctly connect the customer to the service lines. These service lines, radiating from our source of supply, may be likened to the arteries and veins; through them flows the life-blood of the community. All must have light and heat; factories and homes, stores and meeting-houses, all are dependent upon our service. Without this service business and

satisfied existence is suspended. People each day become more accustomed to quick results, and this organization, to supply the public with the great necessities we control, must stand ready to give them as efficient results as they expect, and, if possible, anticipate them, that we may keep apace of the times and not lag behind the procession.

"Contracts are passed from one hand to another, to determine the credit of the party seeking service, to check against errors, to place the necessary meters and give the customers service, and finally to enter the account on our books so that the meter reader may call on our customer at regular intervals and bills may be rendered for service supplied. Every step in this process is important and has a direct bearing upon whether or not we give the customer the prompt service to which he is entitled. Every moment saved along the entire line will show in the final results. Each department working hand in hand with other departments, and each assisting the others insofar as possible, reflects credit on the entire organization and spells success to all."

This paper was the joint product of six of the men whose duties related to getting out the orders for the distribution department. Their suggestions have resulted in the esablishment of the following routine.

First, the contract is received at the application desk, where the clerk in charge is required to be exceedingly particular to get every bit of information required by the questions on the contract form. Thence the contract goes by pneumatic tube to the credit man's desk, where it is passed upon as speedily as circumstances will permit and, if it receives the credit O. K. it is sped to the billing department for its meter number, when it is presumed the contract covers a succession. Back to the credit man again for a moment, so that he may complete his record on it, and straight away to the work-order department, where the "electric meter order" or "electric special order" or both, as circumstances require, are made out on the endless roll forms, four copies being made by the single operation of either typewriter.

Under the old system which had prevailed since the companies were merged in Louisville, the application-contract had gone from the application desk to the commercial department, where the name and address in the body of the contract was copied by typewriter in space provided at the top and record of the contract made. Then it went to the credit man, the billing department, the work-order department and so on to the files. There was no need for the commercial department to see the contract, which it had possibly been responsible for, until the work-order force had translated the terms of the contract into an order for the outside men to execute. Now, these contracts may accumulate in the commercial department until there are enough of them to make it worth while for the stenographer to go through them, and no delay of consequence is occasioned.

As had been the case previously, the messenger service between the work-order department, except in special cases, consists of two trips daily. By reorganization of the force under the superintendent of the distribution department, it is possible now for orders received at 11 a. m. to be executed that same day.

One of the points receiving attention in the new routine involves prompt reports when inspection is completed. Mr.

Electric Bulletin Board for Minneapolis Church.

Montgomery has taken up with the Contractors' Association, which includes practically every electrical contractor in the city, a proposition which promises to work out successfully. This provides that immediately on completing a job the contractor or his foreman shall mail to the city inspection department a double perforated post card, both cards being stamped with one-cent stamps. The first will notify the inspector that the job is finished, and can be used as assignment cards for the men in the office to take with them. When they have finished their inspection and are ready to report it as approved, the inspectors may detach the second cards, which are addressed to the contractor, mark them O. K., and drop them in the first mail-box they pass. When the contractor receives such a report he will promptly notify the electric company and the contract can begin course.

All this refers to new service connections and does not concern the removal orders which, in Louisville as elsewhere, constitute a large proportion of the relations with consumers. The Louisville Gas & Electric Company has adopted the policy of non-removal of its meters wherever that is possible, or wherever the probabilities are that the premises being vacated and the service cut off will be in demand again at some date not long distant. In case of an apartment house or office building where the tenants, buy their own current, the meter is read to make up the bill for the outgoing occupant, who can be depended upon not to leave any lamps behind him, and to give the commercial department the key to future bills. Access to these meters is available, they are inspected regularly and reports on them checked, as in other cases.

When a contract for service of this character is made, the contract goes to the credit man, who checks the name, ascertaining if the patron has heretofore been a good one and acting accordingly. Thence it goes to the billing department, where often it is only necessary to enter the meter number and send the contract on its way to the files, with no need of disturbing the work-order or the distribution departments

Electric Bulletin Board for Church.

If the electric sign can fill stores and theaters with patrons by flashing its message in the eyes of busy people, why can it not be made to fill the pews of the parish church as well? That is the question that Rev. Thomas Graham, pastor of Andrews Presbyterian church, Minneapolis, asked himself one day. The answer to it is a conspicuous yet dignified electric sign on the corner of the church, as shown in the accompanying illustration.

This church stands at the juncture of two streets. The sign is placed at an angle which makes its message easily readable from either street. The announcements are set up in transparent letters which are illuminated at night. And so it is that the people of Mr. Graham's parish are constantly reminded of the special attractions offered in the way of speakers and programs. Those who are interested in one thing may not be interested in another; but all have their special interests, and all will be informed through the medium of the sign board when that which they like is offered. If a parishoner's memory has failed to hold the announcements made at the Sunday service, he has but to notice the sign when he goes by next time on his way to work.

This is one of the first signs of the kind in use in Minneapolis, though there are other churches that advertise the name of the church on large bulb signs.

New Electric Sign in Washington.

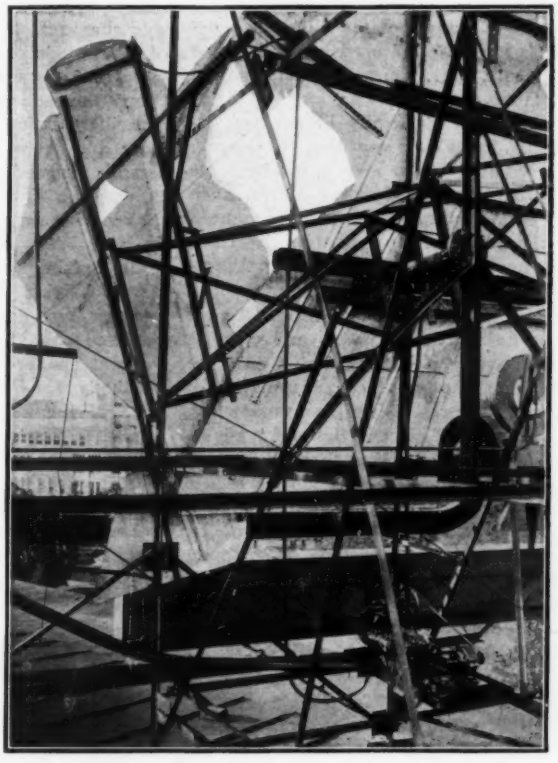
The two accompanying illustrations show a night view and rear construction of a spectacular electric sign advertising Velvet tobacco, erected recently in Washington, D. C. The sign is installed on the roof of the Commercial Hotel, located at the intersection of Seventh Street, North West, and Pennsylvania Avenue, the two busiest thoroughfares of the city.

The Velvet sign is a departure from the usual flashing electric sign in that instead of bringing about the various movements by shifting the lamp circuits, a special mechanical attachment causes the old man to actually lift the pipe out of his mouth. The usual flasher equipment then apparently causes smoke to curl up in a most realistic manner, finally spelling the word "Velvet."

The Betts & Betts Corporation, of New York, built the special mechanical attachment and supporting frame which is similar to the rocking arm of a side-wheel steamboat. To this frame the arm of the man and the pipe are attached. The frame is driven by a small motor which causes the arm and pipe to move up and down, while at the same time the flasher produces the smoke effect referred to.

The sign was designed and built by the Thomas Cusack Company of Buffalo, under the direct supervision of A. Sebert, superintendent of the electrical department. The Betts & Betts Corporation of New York supplied the flasher as well as the rocking arm.

Night View of New Spectacular Electric Sign Installed in Washington, D. C.



Rear View of Washington Sign Showing Type of Construction and Flasher.

Electricity in Rural Districts.

In an address presented at a Commonwealth Conference at Eugene, Ore., on "Electricity in Rural Districts," J. L. White, manager of the Albany division of the Oregon Power Company said:

"It is a fact that it will not pay to make long and costly transmission-line extensions solely for the purpose of serving a scattered farm load, although it is equally true that a farming load will pay as a by-product when such extensions already exist or are being made to take care of other classes of business. Before a great many years the country will be covered by a network of transmission and distribution lines reaching out from a central point to small communities, and incidentally furnishing power for many other purposes along the way.

"It has been demonstrated time and again that the electric method of doing things tends for greater efficiency. Starting with water power converted to electric power we can go on producing forever any mechanical operation. We can re-fertilize our lands, cultivate them, harvest and transport the crops to market, cook our meals, light and heat our homes, etc., and do it efficiently.

"The great problem of all ages has always been to connect the producer and the consumer. If we could produce, distribute, and consume all other products as efficiently and as simply as we can electricity, this great loss between production and consumption would be reduced eighty to ninety per cent."

Physicians' Use of the Electric Vehicle.

The Electric Vehicle Association is in receipt of a letter from a physician in Kansas City—one of the hilliest cities in the country—extolling the virtues of the electric vehicle as used in his practice in the place of five horses for the past six years. He further states that he obtained 12,000 miles from his first set of batteries and the same mileage from his first set of tires. He also advises that the average cost of charging, which he does at home, is $7.50 a month, and that the repairs and upkeep averaged less than $5 a month.

This doctor's experience is that of a large number of physicians all over the country, for the electric appeals especially to them for its low operating cost, its dependability and noiselessness, and particularly for its complete cleanliness, which is a most important factor to doctors.

Electric Sign Data

Modeling of Electrically Lighted Designs.

The process of creating electrically lighted decorative designs for exterior store advertising purposes, particularly during the holiday seasons, was outlined recently by Hugh Cairns, the Boston sculptor, who has designed and modeled many notable Christmas designs for Boston stores during the past 10 years. Mr. Cairns predicts that in a few years American cities will be ablaze with electically illuminated designs, in a manner that is merely hinted at by those now in use by some of the large department stores, such as the Christmas sign of the Houghton & Dutton Company, Boston, described in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of December 19.

"In working out my designs," says Mr. Cairns, "it is always my purpose to show how electric lights may be used to the greatest advantage. In most instances it has been customary, in employing electric lights for advertising purposes, to put them in straight rows or in circles. My idea is to use the lights to make a real design, a picture full of color—something that people will stand to look at for some time.

"No better form of holiday advertisement could be devised. People go home and tell their relatives and neighbors about what they have seen and advise them to come to the city to see these designs, too."

Mr. Cairns points out that, besides being a valuable business proposition, the electric display sign is an added factor in making the holiday season a time of beauty and enjoyment.

Mr. Cairns usually begins the designing of large designs for store decoration about midsummer. The figures are first modeled in wax on a small scale. Then miniature electric lights are experimented with, in various colors, to see what color combinations are most effective. Clear glass bulbs dipped in dyes are used in preference to colored glass lamps because of greater effectiveness in diffusing the light.

The objective aimed at is to provide the greatest possible illumination of the modeled figures, and at the same time disguise the presence of the lamps themselves. To this end indirect illumination is being employed more and more. "The secret of successful designs," says Mr. Cairns, "is to put the lights above, below, and back of the figures, and to give them different backgrounds."

"In making festoons of flowers, we put the lights deep down into each flower. You don't see the light; you just see the glow, which is a deep, brilliant shade at the very center and gradually shades lighter towards the edge of the petals. What looks like a plaster flower in the day time becomes a real flower when lighted; the plaster vanishes, and you have only form and color."

The use of ornamental cups and fixtures, chandeliers and brackets, scrolls, shells, etc., is serviceable in giving full artistic effect. Such additional helps lend warmth and brightness to the picture.

Double-face sign of inexpensive design suitable for lunch rooms.

The sign measures 9 feet long by 2.5 feet high and contains 168 five-watt lamps, 84 to a side. The word "Cafeteria" is in 16-inch letters.

Background is green glass smalt. Flashing effect provides for lighting each word at a time, then all off, then all on, and repeat.

New regulations having to do with the construction of roof signs in the metropolitan district of Boston require that the signs and their frames shall be of non-combustible material and that the bottom of every sign shall be not less than four feet above the roof of the building on which it is erected.

The *Electric Sign Journal*, published by J. H. Donnelly at Syracuse, N. Y., transferred its headquarters to New York City on January 1, 1915.

In describing the new Orpheum Theater which recently opened its doors to the public at Ft. Wayne, Ind., the *Gazette*, a daily newspaper of that city, makes the following interesting comment on the electrical display.

"The front of the building is artistically finished in white-enameled brick and stone and is highly illuminated with 3,100 lights. By an ingenious arrangement of flashers the front lights are operated in the chaser system which makes a complete circle over the front of the building. The chaser system together with the large electric sign which projects sixteen feet above the roof of the theater has been furnished by H. Brinkman, who has gained an enviable reputation in this state for such work.

"The immense sign, which lights the way to the new theater for many blocks, is so composed and connected with flashers, that the illustration is that of a pig jumping from the ground up through a hoop held over the clown's head from there onto a table and back to the ground."

Electrical Construction

Ozone Apparatus as a Business Proposition.

In view of the keen competition existing today in all branches of the electrical industry it is somewhat surprising that the possibilities of ozone as a business proposition for the small and large electrical dealer have been so little appreciated. There are probably few dealers who have even gone so far as exhibiting an ozonizer in their display window, and therefore the following outline of the use of such apparatus and suggestions as to methods of selling may be of interest. Ozone is an allotropic form of oxygen. Although it may be produced either chemically or electrically only the latter method is used commercially on account of the cost and complication of the apparatus needed for the former. As is well known, oxygen combines freely with most substances and has the chemical symbol O_2. If an electrical discharge is allowed to take place in a vessel containing oxygen a third atom is forced into combination and the chemical formula becomes O_3. This O_3 is known as "ozone," and being naturally a somewhat unstable compound the third atom readily attacks any oxidizible material with which is comes in contact. It is far more energetic in this respect than it was previous to the electrical treatment.

Ozone purifies the air in the following manner: Air is vitiated in several ways. Firstly, all living beings consume oxygen, and this after purifying the blood in the lungs is exhaled in the form of carbon dioxide which will not support life. It is not, however, actively poisonous—merely useless—and has no smell and scarcely any taste even when concentrated. Secondly, the air is vitiated by organic matter in a very finely divided state, this being given off from the lungs, clothes and skin of those present, or from food, etc. These exhalations cause the unpleasant taste and smell of the air in crowded rooms, restaurants, etc., where no sufficient ventilating system is in use. It may be merely objectionable or positively dangerous according to circumstances. Lastly, there is the heat and moisture produced by the occupants of the room in question. Of these three causes it will be seen that by far the most undesirable is the second. The concentration of carbon dioxide which would be needed to produce evil effects is practically never met with in any ventilating problem.

The apparatus for producing ozone is always operated by alternating current and therefore when only direct current is available a rotary converter must be interposed between it and the source of supply. This would appear to involve considerable extra expense, but as a matter of fact it need not do so, for as it is always advantageous to fit a fan to the apparatus to distribute the ozone evenly throughout the air to be purified, this fan may very conveniently be attached to the converter, the shaft being provided with an extension for this purpose. This saves the extra cost of a motor to drive the fan. The ozonizer itself is practically a condenser between the poles of which a "brush" discharge is produced by a small transformer whose secondary circuit is arranged to generate the high voltage necessary.

When ozone is introduced into an atmosphere which is permeated with the organic matter in suspension already mentioned it at once attacks the compounds of which it is composed and reduces them to carbon, hydrogen, sulphur, free oxygen and other harmless material. None of them are injurious nor have they any odor. The action of ozone upon tobacco smoke is somewhat similar. Tobacco smoke is composed of very minute particles of carbon dust mixed with organic matter. As the result of the activity of the third atoms of oxygen in the molecules the organic vapors are destroyed and the carbon tends to settle to the ground. Thus in addition to its deodorizing effect an ozone machine actually helps to remove the smoke itself. This is an advantage which should not be lost sight of as a selling point, for it affords an ocular demonstration of the benefits resulting from the use of the apparatus. It should be remembered that the eyes of most people are much keener than their noses in comparative tests—probably because we do not train our sense of smell to the same extent that we do our eyes. The effect of ozone on micro-organisms and bacteria varies with the degree of concentration, for although it is quite true that the pure ozone used in therapeutic work has a powerful germicidal action such a gas would not be at all suitable for breathing purposes for any length of time. On the other hand even a weak solution indirectly destroys the microbes present in the vitiated air by destroying the organic particles upon which they live. For the same reason ozone has a preservative effect on food stuffs which come under its influence and is used in some cold storage houses for the purpose of economizing the supply of ice since a higher temperature may be permitted without risk of spoiling the goods preserved therein.

The prospective customer will very possibly argue that he doesn't need an ozonizing plant because he has already fans fitted up throughout his factory or office as the case may be. It has been found, however, from a series of tests that when a suitable ozonizer is used only one-third of the volume of air needs to be passed through the space to be ventilated than would be the case if the apparatus not used. An ozonizer requires only a very small current. There is one type which only needs 18 watts and if it is assumed that for the sake of insuring a thorough distribution of the ozone the device is placed in front of a 60-watt fan, the total cost per hour at 10 cents per kilowatt-hour is 0.78 cent. To produce the same ventilating effect without the ozonizer would require three 60-watt fans costing on the same basis 1.8 cents per hour or more than double and the larger the installation the more important the difference in cost becomes. Moreover, if the room is fairly small, such as an ordinary living room, it would not be necessary to have a fan behind the ozonizer at all, thus reducing the cost to one-tenth of what it would be with fan ventilation. The following details regarding the number of ozonizers required for purifying the air in theaters of various sizes is based on Westinghouse machines:

Seating Capacity.	Number of Machines Required.
150—	1
150— 300	2
300— 500	3
500—1,000	4
1,000—1,500	6
2,000—3,000	10

The cost of producing 1,000 cubic feet of strongly ozonized air at 10 cents per kilowatt-hour by the Westinghouse machines works out at 0.013 cent per hour.

With regard to the suggested methods of selling ozonizers, this business is one which does not need a great amount of capital to carry out a selling campaign, and the fact that the price of an ozonizer outfit varies from as low as $10 for small portable devices to several thousand when it is a question of a complete plant for an office building or similar job enables the contractor to interest a large number of people. A steady follow-up campaign by mail followed up with a personal call in promising cases will result in a good percentage of results if carefully handled. Even if in some instances no actual order for ozonizers is secured at the time, the fact that the contractor is handling a distinctive line of this sort is in itself an advertisement for him, and will impress the prospect accordingly. Thus a deal of some sort or another will be effected before long. Among those written to should be included the following, hotel proprietors, saloonkeepers, owners of amusement halls, billiard hall managers, business men generally (for office and factory ventilation) and cold-storage companies (for improving the taste of chilled meat and economizing in the cooling cost).

In the event of the contractor desiring assistance in publicity matters the makers of ozonizing apparatus are always pleased to assist him in every way in their power, and will usually supply literature overprinted with the contractor's name and address on request. It goes without saying that a good window display is of the utmost help, and an ozonizer or two should always be kept at work in the shop. A printed invitation to "Step inside and sample our fresh air" will certainly attract notice and if once the prospect can be lured inside the shop a sale of something is pretty sure to result. The same invitation might also be embodied in the circular letters. The local central station should also be approached so as to secure its co-operation. It can be demonstrated that although the average consumption of current in kilowatt-hours per user connected to the mains may be small, the load is practically an all-day one, and in the case of private houses where ozonizers are installed in the bedrooms as well as the living rooms, an all-night one as well. In view therefore of the large number of people to whom a continual supply of fresh pure air at a nominal cost will appeal, the total load which may be reasonably anticipated will be of sufficient magnitude to secure the company's assistance. Another point which will appeal to the utility is that an ozonizer, unlike a fan, is almost certain to be in use all the year round. Concrete figures are of course difficult to give but the revenue produced should be at least as great as that produced by the fan load in a very short time after the beginning of a selling campaign in the district.

Kansas City Has Municipal Electric Shop.

A municipal electric store, with Charles S. Harriman in charge, has been opened at Kansas City, Kans.

Hughes ranges are evidently going strong. The city gives a rate for cooking of three cents per kilowatt-hour, a special meter being installed, the customer paying for the loop from $4 to $8. Hotpoint, American Electric and Westinghouse equipment are shown, one show case being already in place. The store is located in the lobby of the second floor, outide the general offices of the light department. The electric store is using the "Mrs. Thrifty" moving pictures of the Westinghouse Electric & Manufacturing Company, which will be shown in 14 different picture houses.

The Kansas City, Kan., municipal plant serves many of the domestic consumers of Kansas City, Kan. The Standard Electric Company, the corporation selling current of the Kansas City Electric Light Company and of the Metropolitan Street Railway Company, has many domestic consumers, and now serves most of Argentine, one of the sections of the city. The Standard has a large share of the power consumers, although the city is furnishing several large plants. The Standard will withdraw from Argentine on March 1, 1915, and will take down its poles and wires. On that date the Standard will also, under the terms of an agreement, withdraw largely from the business of supplying industrial power, the city taking over what business it is at that time able to handle. The city is working fast on the increasing of the capacity of its plant, to care for domestic as well as power customers in sight. The city has recently purchased a 5,000-kilowatt generator from the Allis-Chalmers Manufacturing Company, and two 300-horsepower boilers, 1,000 poles and 80,000 pounds of No. 6 and No. 8 weatherproof wire. Wire will be bought soon for a 6,600-volt feeder from Quindaro, the plant, to Tenth Street and Kansas Avenue, about three miles distant, to duplicate the downtown feeder. L. H. Chapman, commissioner, and E. N. Stevens, consulting engineer, are working on specifications for new equipment.

Uphold Inspection Fees.

The Pittsburgh Electrical Association is opposing a proposed ordinance of the City Council which would abolish the fee for electrical inspection.

New Officers of Oregon Association.

The following officers of the Oregon Electrical Contractors' Association were elected at the recent convention:

President, John R. Tomlinson, of Portland.

Vice-Presidents, Harry Sroufe, J. H. Ralston, Lester Armitage.

Secretary-Treasurer, J. W. Oberender, of Portland.

Executive Committee, F. L. Green, S. C. Jagger and above officers.

Among the Contractors.

The Mitchell and Cross Company has succeeded the Mater Electric Company at Guthrie, Okla. This company recently completed the construction work on a 13-mile transmission line between Shawnee and McLoud Okla.; also the distributing and street lighting system in McLoud.

The Beck Electrical Construction Company. Minneapolis, Minn., just completed the complete electrical installation in the Prospect Park Methodist Episcopal Church. The main auditorium and balcony are illuminated by special indirect lighting fixtures, designed and built for this job. The same company has handled the following jobs:

The complete electrical installation in the First Methodist Episcopal Church. The church is lighted by means of 300-watt nitrogen-filled lamps.

A special installation in the Trinity Baptist Church.

The addition to the Minneapolis Artificial Ice Plant, including re-connecting the present outfit, re-arranging switchboard, panels and conduit in the old plant.

A 2,300-volt installation for the Twin City Box Company and another 2,300-volt installation for the Minneapolis Manufacturing Company, these installations including switches, transformers, etc.

Over 175 apartments with complete electrical installation of lighting, signal systems and telephones. In a number of these installations fixtures and lamps have also been furnished.

Charles Bartz has opened an office in Ayer, Mass., for the doing of electrical work in that town and vicinity.

The Jackson Electric Company, La Fayette, Ind., has recently secured a number of important electrical contracts on which work is now being carried on. One of these is the complete electrical equipment of the St. James Lutheran High School and a double-apartment residence belonging to the same institution. The wiring is all in rigid conduit; a vacuum cleaning sys-

tem will be controlled from all the floors; fire gongs and telephones are liberally provided in various parts of the building; the auditorium will have a large stage, equipped with modern theater dimmers, orchestra lights, etc. The Jackson Electric Company has also secured the contracts for wiring the Grove flats, the Viol flats, the Wilson mansion and several smaller residences.

Philadelphia Electrical Conference Discusses Control Equipment.

At a meeting of the Philadelphia Electrical Conference held in the Quaker City on December 17 there was an attendance of 253 electrical mechanics. Richard Bishop, engineer of the Cutler-Hammer Manufacturing Company, gave a practical demonstration of direct-current and alternating-current motor-control apparatus. A great many interesting questions were asked by the practical men present, men actually handling the equipment in service. These were cleared up to the satisfaction of these practical mechanics by the speaker, a trained technical engineer of broad experience, who remarked at the close of the evening on the valuable knowledge there was to be gathered from these practical men. He modestly asserted that he felt he had benefited more than any one present. This is not surprising, however, said Washington Devereux, chairman of the Conference, for the practical man is called upon to cure diseases of apparatus not anticipated by the manufacturer and it is at meetings of this kind that the technical engineer and practical electrical worker meet on the level and the information secured is often more valuable than can be found in the majority of text books on these subjects.

Public Service Commissions

Conducted by William J. Norton

CALIFORNIA.

The San Joaquin Light and Power Company was granted authority to absorb the following subsidiary companies: Selma Water Works, Madera Water Works, Madera Light and Power Company, Lemoore Light and Power Corporation and the Bakersfield Gas and Electric Light Company.

The Western States Gas and Electric Company was authorized to issue $101,000 of its five-per-cent bonds at not less than 82.5 and accrued interest, in lieu of $142,700 of its three-year notes previously authorized by the Commission.

Richard Sachse has been appointed chief engineer of the Commission. Mr. Sachse has been acting chief engineer since December 1, 1913. He is an associate member of the American Society of Civil Engineers and a graduate of the Royal Technical Institute of Dresden, Germany. He was secretary to the chief engineer of the joint government board of Germany, France and Great Britain on preliminary railroad investigations in West Africa.

LOUISIANA.

The Vicksburg, Shreveport & Pacific Railway Company applied to the Louisiana Railroad Commission for permission to discontinue certain of its trains. The Commission says: "It should be borne in mind that during times of great public stress such as at present, every class of business is retrenching, and the corporation managers who are responsible for the proper operation and conduct of the great transportation lines, must look to the husbanding of resources, in order that these great developers of our resources shall not go backwards, but shall continue to improve and advance.

"The Commission must consider and act upon all applications for relief from its rules, regulations or orders when changed or altered conditions cause them to be oppressive, and, in fairness to all must grant relief. The public can at all times come to the Commission when train service is inadequate, or the carriers fail to provide that which is necessary. Holding these views, the Commission has carefully considered this application with a realization that the public looks to it for protection against unfairness and also that the carrier is entitled to its full measure of justice."

NEW JERSEY.

Lakewood Water, Light and Power Company. One of the customers of the water utility who owns his meter refused to permit the company to remove the meter from his premises for the purpose of testing its accuracy and further insisted that it should not be sealed. The company continued service to the consumer, pending a decision by the Board as to the company's rights in the matter. The Board held that the actual ownership of the meter did not affect the company's control over it. The fact that a patron is required to pay for the meter affects only the rates charged for the service, and it is not only the right, but the duty of the water company to seal all meters and to examine and test them whenever necessary.

NEW YORK—First District.

The Consolidated Gas Company was granted authority to issue $25,000,000 convertible six-per-cent debentures to be sold before December 31 for not less than their face value and accrued interest. The proceeds will be used to reimburse the company for funds expended in purchasing the stock of the New York Edison Company and of the Astoria Light, Heat & Power Company, and to discharge $5,000,000 collateral trust notes and $2,500,000 demand notes. The debentures are convertible, after three years, into stock which the Commission also authorized to be issued in the amount of $25,000,000.

Commissioner Maltbie wished to suspend action on this order until the Consolidated company had applied for the legalization of certain stock, which it issued without authorization to redeem debentures. His suggestion was voted down 4 to 1.

NEW YORK—Second District.

Westchester Lighting Company Cases. In an opinion rendered by Commissioner Decker, the Commission has decided the cases brought by the complaints of residents of White Plains, Port Chester, Tarrytown and North Tarrytown, Irvington and Eastchester against the Westchester Lighting Company. The Commission finds that the company's maximum rate for electricity of 15 cents per kilowatt-hour in the districts above named is excessive, and this rate is lowered to 12 cents per kilowatt-hour. The company's minimum charge of $1.00 is reduced to 75 cents.

In regard to the gas rates in these districts the Commission holds that the company's income does not afford a rate of return which can be reduced by

lawful order in these proceedings. But the Commission recommends that the company reduce its rates to $1.25 per 1,000 cubic feet as a general rate, and states that even lower rates may be justified in thickly settled portions of the territory served.

The bulk of interest-charge increases in the last four years, reducing the Westchester company's net revenues, are due to the $10,000,000 mortgage bonds and the $2,500,000 debenture bonds placed on the property in 1904 in the transfer of control to the Consolidated Gas Company. This transfer was made before the establishment of the Public Service Commission and is not given weight in the decision. The Commission says it is greatly to be regretted that the company's enormous interest charges, arising out of securities having little, if any, relation to the actual property account, tend to force the company to secure every penny possible in gross earnings, and limit the margin with which freely to undertake gas-rate reductions which would place its large business in these districts upon a basis of rates whereby customers would have some greater inducement to indulge in freer use of gas for fuel purposes and also for light.

In reviewing the valuation submitted by the company the Commission shows that percentages claimed by the respondent upon the labor and material items used in reproduction-cost tables amount to 65.36 per cent in addition to the base or unit prices, and says there can be no justification for such tremendous overhead expenses in a reproduction cost of the property. The Commission does not allow 15 per cent which the respondent terms "contractors' profit," and shows that no proof whatsoever was furnished concerning what a contractors' profit would be. The Commission reduces respondent's estimate of 20 per cent for intangibles, allowing 10 per cent. The Commission points out that there has been no proof whatsoever of any detailed intangible costs and says that intangible costs are primarily a matter of company records and come within the domain of the accountant and not within that of the engineer. Intangible costs constitute no part of the work of the constructing engineer, and it is as such that the part of the expert engineer, testifying in a valuation case, can be regarded. Only his qualifications as a constructing engineer give him any standing as a witness in proceedings of this character. A mere estimate for intangibles is insufficient. The whole matter of intangibles is treated at length. The Commission also treats at length the subject of depreciation and in the same connection the company's established depreciation reserve.

The Albany Southern Railroad Company was granted permission to exercise franchises for furnishing electric current for light, heat and power in the town of Schodack, Rensselaer County. The territory in which the company may operate was restricted so as to protect the rights of the Schodack Light and Power Corporation. Neither company can operate across the dividing line without further permission.

The Utica Gas and Electric Company was authorized to issue its refunding and extension five-per-cent fifty-year gold bonds, to finance extensive improvements in its plant at Utica; $500,000 of the bonds are to be sold at not less than 98 to net $490,000.

OHIO.

The Sidney Electric Company was authorized to issue $42,500 par value of its common capital stock and its six-per-cent mortgage bonds of $60,000, the stock to be sold for not less than par value, and the bonds for not less than 85 per cent of the par value. The proceeds from the sale of these securities will be used in purchasing the property of the Sidney Electric Light Company and in defraying various expenses incident to this purchase, which was previously authorized by the Commission.

WISCONSIN.

The Whitewater Electric Light Company, by a decision rendered December 26, 1914, was authorized to adjust rates for electric service. The rates in effect were found to be regressive and the new rates proposed by the company eliminated this undesirable feature and reduced the rates to the general body of consumers.

The proposed schedule contains provision for a minimum charge and a reconnection charge. The decision says:

"The Commission has had occasion in a number of cases to investigate the reasonableness of minimum charges for electric service, and in a general way it may be said that a minimum charge of 75 cents per month has been found reasonable. It is true that in one or two cases which have come before the Commission a minimum charge of 50 cents per month has been established, but we are inclined to believe that 75 cents is reasonable in this case. . . .

"The company asks also that it be given authority to charge $1.50 for reconnection of a meter for the same consumer upon the same premises within one year of the date when service was disconnected. This has been held to be a reasonable provision in other cases before the Commission, and we see no reason for not authorizing such a practice in this case."

Public Utility Company Suffers Severe Imposition in Rate Investigation.

Practically all the books and records of the Washington Water Power Company were thrown open to the attorneys, accountants and engineers of the Federal Mining and Smelting Company of Coeur d'Alene by the order of the Public Utilities Commission of Idaho issued December 19.

Unsuccessful in a similar application some months ago, the mining company took the matter to the courts and obtained there a decision which, though it refused to alter or annul the order of the Public Utilities Commission, was worded in such a way that the Commission considered it an instruction to give the mining company practically free rein for its investigation.

Accordingly, when the matter was again brought to the attention of the Commission, the power company was instructed to furnish certain named books and any others which contain references to the mining company. The investigation is for the purpose of securing evidence that the power rates furnished to the Federal Mining Company are unjust and unreasonable.

Following are the records ordered opened to the mining company: balance sheet for 1904-13, all ledgers and journals, the minute book in which reference is made to the million-dollar bond issue and the half-million-dollar issue, a complete list of the names of the customers of the power company, past and present.

Other books not named specifically are such as contain any entries or facts pertaining to the power company as follows: original cost of plant, amount expended from year to year in permanent improvements and extensions and the cost value of any and all property acquired by the power company; the amount of the stocks and bonds issued and outstanding, the revenue derived from their sale and the amounts of the issues; items of all receipts and their source, items covering all operating expenses and the purposes for which they were paid, including fixed charges and all other expenses and losses on account of upkeep, depreciation and obsolescence; all dividends declared or paid; names of all customers and consumers, the nature of the service furnished each and the receipts from each account. Furthermore, the mining company is allowed, upon five days' written notice to the Commission, to inspect any other books which may be found to be material or pertinent to the issues involved.

It is expected that the power company will attempt to secure the nullification of the order through the courts.

New Electrical and Mechanical Appliances

Presto Electric Hand Lamp.

Believing that the development of the high-efficiency and concentrated-filament form of small tungsten lamps makes it practical to use convenient electric lanterns operated from dry cells, the Metal Specialties Manufacturing Company, Incorporated, 736 West Monroe Street, Chicago, Ill., has placed on the market a compact equipment that can be readily applied to any of the ordinary No. 6 size of dry cells. The illustration herewith shows the simplicity of the equipment and makes clear how it may be quickly attached to any cell of this type. If the cell has an extended carbon, the vertical slot is used for fastening to the

Electric Hand Lamp.

carbon terminal; if it is of the flush-cap-carbon type, the round hole in the horizontal foot piece at the bottom of the supporting yoke is secured directly to the carbon terminal.

This supporting yoke serves both for holding the tilting lamp and the handle and at the same time it serves for one of the electrical connections. The other electrical connection is made through a flexible cord fastened to the switch at the rear of the lamp casing. This cord has a terminal for attachment to the zinc terminal of the cell. The lamp may be tilted through any angle, which facilitates directing the light when the outfit is standing on the table or shelf.

The outfit is inexpensive in cost and economical in operation. It can be used for all purposes for which a convenient and safe hand lamp is desired. It can be held in the hand, carried by the handle or hung up thereby. A two-inch bull's eye lens and a powerful reflector back of the lamp serves to throw the light to a long distance. The outfit is absolutely safe around gas, gasoline or other highly inflammable substances.

Standard First-Aid Jar.

The Conference Board on Safety and Sanitation of the National Affiliated Safety Organizations, of which M. W. Alexander, General Electric Company, West Lynn, Mass., is secretary, has provided the N. A. S. O. Standard First-Aid Jar to meet the requirements

First-Aid Jar.

of a compact, convenient and sanitary first-aid outfit. This jar is made of glass, which is considered superior to wood or tin for the purpose. It is strong, specially annealed, and has smooth surfaces. The glass cover has a handle molded in it, and is held on the jar by spring clips which are part of a metal cage in which the jar sets. A rubber gasket between the two makes the outfit dustproof. This jar contains a large number of articles which have been found necessary for effective first-aid treatment by laymen. It is 9.5 inches in diameter and 6 inches high. Instructions for use are printed on the inside of the cover, while on the outside there is a standard list of first-aid materials which should always be kept in the jar.

Where it is desired to keep the jar on a wagon used in connection with outside construction work, it should be kept in the padded shipping box which is provided. This jar is furnished at approximately the cost of the materials, and may be obtained from the secretary of any of the associations comprising the Conference Board. Among these is T. C. Martin, secretary of the National Electric Light Association, 29 West Thirty-ninth Street, New York City.

A New Portable Electric Drill.

The drill illustrated herewith is suitable for all drilling services where a revolving tool can be used. The design is such as to make it especially convenient for use in corners or near obstructions.

The outfit is so shaped and balanced

Motor-Driven Portable Drill.

with relation to the grips that it is particularly easy to handle. Its control is especially unique and effective, being similar to that of an automatic pistol. One finger does the work and consequently the grip on the outfit and the aim is not obstructed in operating the control. This prevents breakage of drills and enables the operator to drill more accurately than he can with a tool when it is necessary to release his grip to turn the switch, or press a button to control the drill.

Housings of the drill are cast from a special high-duty aluminum alloy, having a very high tensile strength and resistance to distortion, making the outfit light in weight and easy to handle,

yet strong and rugged in hard service.

The gears are of nickel-steel, heat-treated to give them long life, and are cut from the solid. The chuck spindle is hardened and ground. It runs in a special high-speed bronze bushing and the end thrust is taken care of by a ball thrust bearing. Separate means for both oil and grease lubrication are provided, and all gears are constantly bathed in non-fluid grease in a grease-tight compartment.

A universal motor is used, which operates on both direct current and alternating current. It is manufactured by the Robbins & Myers Company, Springfield, O. It is liberally proportioned and will carry heavy overloads. A forced-draft ventilating system insures cool operation under overloads. The commutator and brushes are readily accessible. The inclosing cover does not carry the armature-shaft bearings, as in most types of drills. The bearings and brushes are carried on a separate inner spider, which is protected from the external strains which tend to cause binding in the bearings. This construction also permits inspection of the commutator and brushes while the drill is running.

Each drill is furnished with 10 feet of heavy conductor cord and a plug. If desired, a breast plate or combination spade handle can be furnished in place of the rear grip shown in the illustration. In the larger sizes a second removable side grip is placed opposite the switch grip, and an "old man" is furnished in addition to the rear grip for heavy drilling.

The outfit is made in two sizes for operation on 110 and 220 volts. It is manufactured by the Black & Decker Manufacturing Company, Baltimore, Md., and is known as the B. & D. Type A Close-Corner Drill.

Series Transformer for Gas-Filled Tungsten Street Lamps.

The rapidly increasing use of gas-filled tungsten lamps for street lighting is directing attention to equipment for promoting the highest efficiency possible with this type of unit. It is well known that this type of lamp gives its highest efficiency when it is supplied with heavy currents, say 15 or 20 amperes. For this purpose fixtures including autotransformers, or compensators, have been furnished by a number of manufacturers. A new type of transformer, especially designed for this purpose and which is said to have some advantages over the autotransformer, has been placed on the market by the Kuhlman Electric Company, Elkhart, Ind.

This transformer has its primary and secondary windings entirely distinct, in fact insulated with a very heavy insulating wall which is tested to withstand a pressure strain of 20,000 volts. The primary is connected in series with the series street-lighting circuit. The secondary is connected directly to the lamp terminals. Each lamp is entirely independent of every other and no general interruption of the circuit can follow an accident to one or more lamps. This type of transformer can be used on circuits containing from 10 lamps upward and the series circuit containing the primaries can be connected directly to the source of supply or to a step-up or step-down transformer with voltage taps connected to the source.

The use of a constant-current regulator in the series circuit is dispensed with. All that is necessary is to provide the main series circuit with the proper voltage for the number of lamps connected. The transformers themselves maintain the lamp current constant within one per cent of rated value,

Kuhlman Series Transformer for Gas-Filled Tungsten Lamp.

this regulation being maintained if any number up to one-fourth of the total lamps should burn out or be removed. If more lamps should burn out, then the current in the remaining lamps falls gradually to a point to where the illumination diminishes appreciably, but no injury can be imposed on the remaining lamps. If a considerable number of the lamps should be burned out or removed, the voltage supplied to the series circuit can be readjusted. The individual transformers absolutely take care of any conditions brought about in the circuit by lamps going out or being removed.

Since the primary and secondary of each transformer are completely independent electrically, this insures having the lamp free from high-potential current. The lamp, therefore, can be taken care of by a lineman or trimmer with perfect safety. The secondary voltage is only 15, 20 or 25 volts, depending upon the size of lamp used.

This type of transformer can be installed both on overhead and underground circuits. In the case of ornamental-post lighting from underground circuits the series supply circuit is installed in conduit or in steel-armored cable with the small transformer in the base of the post; since no high-voltage wires enter the post at all and only the low lamp voltage must be taken care of, the need for expensive high-voltage conductors in the post is dispensed with and the liability for trouble eliminated. In the case of the overhead construction, the transformers may be suspended from the cross-arm or arranged for mounting directly above the lamp fixture. A circuit containing these transformers in full operation has a power-factor of 99 per cent or practically unity. The transformer efficiency is about 93 per cent.

Great care is taken in every feature of the construction of the transformer. The primary or high-tension terminals are brought out on opposite sides and well insulated. Terminals for the low-voltage secondary are brought out at the bottom. Only high-grade materials are used. The design is well proportioned and compact.

Automatic-Resistance Horn-Type Lightning Arrester.

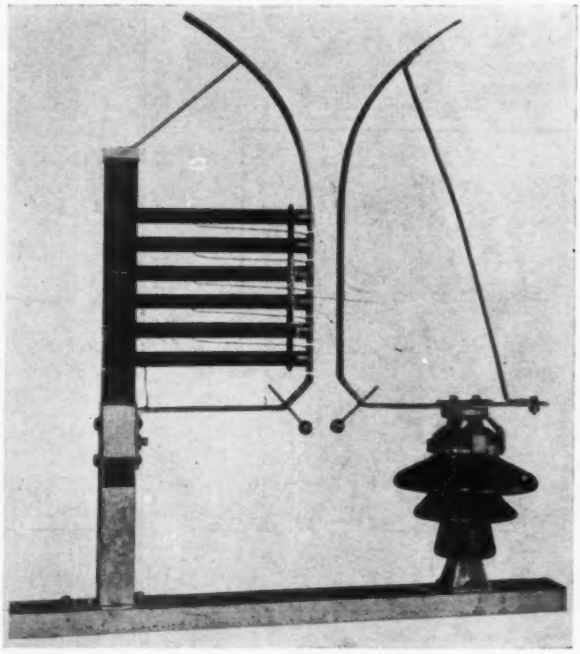
The ideal lightning arrester is one which offers instantaneous relief from abnormal voltages, but which prevents the flow of dynamic or generator current after the abnormal voltage has been relieved without producing any disturbances on the system upon which it operates.

The S & C automatic-resistance horn arrester recently placed on the market by Schweitzer & Conrad, 1770-1774 Wilson Avenue, Chicago, Ill., for use on circuits of from 11,000 to 66,000 volts, is a very ingenious device for accomplishing the above results. As seen in the illustration, the arrester consists essentially of a horn gap and a number of resistance units so arranged that as the current rises up the horns the resistance is automatically cut in step by step into the circuit. Thus, without any moving parts, the current is rapidly cut down so that it breaks easily and without any serious voltage rise. It will be noticed that a sphere gap is also inserted in parallel with the horn gap to assist the dissipation of very-high-frequency waves, such as occur when charging an adjacent line, switching, and other similar causes.

The chief difficulty experienced with horn gaps is that of breaking the arc rapidly and permanently without setting up oscillations and dangerous pres-

sure rises. The current is generally so heavy, that the arc is slow to break, and when it does finally break it does it so suddenly that a high-voltage rise occurs, which causes the arc to start across the bottom of the horn again.

As will be seen from the illustration, the height of the new S & C horn is comparatively small for a given voltage. Unlike most horns the sides of this horn rise parallel to each other until the resistance units have all been passed by the arc as it rises up the horns, when they diverge. The result of this is that the arc tends to rise very rapidly indeed, driven upward by the rush of heated air currents. As the dynamic current rises up the horns it is cut down in value, as the ever-increasing resistance becomes effective, and the strength of the arc weakened accordingly, until the divergent portions of the horn are reached, when the thermodynamic and electrodynamic forces coact to drive the arc, or what remains of it, up the horns to self-extinction. It should be noticed that the discharge goes direct across the horn or sphere gap to earth, whereas the dynamic current, after the first instant, from the properties of the electric arc, or the tendency to rise upward, necessarily goes to ground through resistance.



S & C Automatic-Resistance Horn-Type Lightning Arrester.

When an arc exists in a circuit containing inductance and capacity oscillations tend to be set up. Such oscillations can, however, be prevented and the oscillation dampened out if a resistance equal to, or greater than, the critical resistance be connected in series. This the S & C arrester automatically accomplishes. This horn gap and combination of resistance has proved remarkably effective in limiting, and quickly suppressing the dynamic current without in any way interfering with the free discharge of abnormal voltages.

The arrester is suitable for a large range of operating voltages, on systems employing grounded or ungrounded neutrals. The adjustment for the different operating voltages is carried out by decreasing or increasing the horn gap, a simple matter of loosening two screws. The resistance units are strong, of ample capacity and are unaffected by weathering. The arrester has an enormous discharge capacity and thus is not only able to discharge large quantities of lightning but can take care of both continuous and recurrent discharges with ease. The question of overheating is not likely to enter.

It is well known that circuits of comparatively low voltage suffer more from lightning effects than do very-high-voltage lines, notwithstanding the larger factor of safety of their insulation. In other words, the higher the insulation of a line the more immune will it be from trouble in this respect. The best protection against the effects of lightning, whether it be from external or internal causes, is to insulate the line as highly as it is feasible to do so, and introduce weaknesses, namely arresters, at frequent intervals. As the S & C arresters are very sensitive to voltage rises they are most efficacious for the protection of equipment and are highly recommended by the manufacturers for installation at the entrance to all stations and substations, whether of the indoor or outdoor type. For this latter class of stations, where they may be isolated and forgotten after being once installed, their substantial construction, the absence of moving parts, and the fact that they require no regular attention, makes them particularly desirable.

It is now also quite well known that insulator failures generally occur slowly, the porcelain receiving numerous punctures before the final breakdown actually occurs. Expressed in another way, it is not the occasional surge that causes a line to fail, but the cumulative effect of individual surges which reduce the dielectric strength of the insulators until they are unable to withstand the stress. It has become the custom to leave transmission lines without protection, except perhaps that afforded by the overhead grounded conductor, and not including the arresters in the neighborhood of the stations and substations which are for the protection of station equipment rather than for the line. This custom is the outcome of necessity rather than choice, because until quite recently suitable arresters for the protection of transmission lines have not been available at reasonable cost. Lightning strokes are, as a rule, so highly localized in effect, due to their steep wave-front, that spillovers and shattering of insulators generally follow, unless an arrester is in the immediate field of influence.

It is claimed by its manufacturers that the S & C horn-gap arrester is well fitted for this purpose, namely not only for the protection of stations and substations but for use anywhere along a transmission line, as past experience dictates or the topography of the country suggests. The arrester can be placed wherever it will be most effective without fear, because it is rugged and strong, there are no moving parts, and nothing to get out of working order. The insulators used on these arresters are so chosen that the spillover voltage is several times that of the arrester; they are thus able to successfully withstand the piling up of steep-front traveling waves of potential, such as the arrester is designed to discharge. The arrester is securely mounted on a substantial steel channel frame. All steel parts are well galvanized, hence worry and expense for maintenance due to moisture and other weather conditions are eliminated.

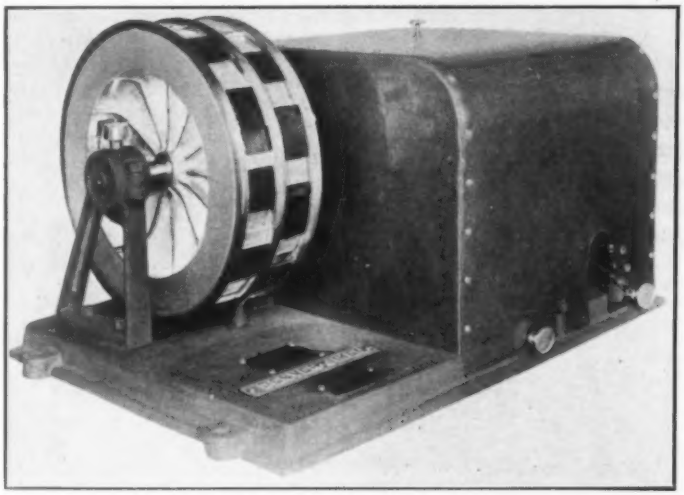
In the matter of cost, which is essentially a practical one, this new arrester has a marked advantage over other arresters, for it is very low priced, while the cost of maintenance is practically nil. Not only do actual installations of the S & C arrester show a considerable saving in the first cost of obtaining protection, but the superior protection afforded, and the saving in cost of insulators and equipment accruing therefrom, together with the better service record, are becoming more and more apparent as time goes on.

The Portuguese government has made an appropriation for the establishment of a long-distance wireless station at Lisbon to be operated by the navy.

Motor-Driven Fire and General Alarm Siren.

In many small communities, particularly of industrial character, as well as in large industrial plants, there is need of a powerful and distinctive general alarm signal. What is known as the Denver Siren was constructed by the Hendrie & Bolthoff Manufacturing & Supply Company, Denver, Colo., in order to supply this need by a motor-driven device that would create a distinctive sound suitable for fire and general alarms, and that could be operated by a switch placed alongside of the operator at the telephone central office or at any other suitable place or places.

The revolving part of the siren is made of aluminum, mounted upon Hess-Bright ball bearings, and the outside portion, or stator, of bronze. The rotor does not touch the stator at any point and thus revolves very easily. The siren gives the best results when equipped with a three-phase induction motor, and it is guaranteed to be constructed properly from mechanical and electrical standpoints. A single-phase motor can be used, but three-phase power is recommended as being more satisfactory.



Motor-Driven Alarm Siren.

When the switch is closed, the pitch increases quickly from the deepest audible sound, made by about 16 vibrations a second, to the sound made by 700 vibrations a second, which is about the same as high *C* (two octaves above middle *C* on a piano). The switch can then be opened and closed at intervals of two to five seconds, and the pitch varied at will. The sound so produced is very penetrating indeed, as was indicated by the telephone calls that came in over the rural lines asking what was the cause of the noise in Longmont, Colo., when the siren was tested there. One of the telephone operators traced down enough of these calls to prove that the sound was distinctly heard at distances of five miles in opposite directions.

The siren should be placed upon a building or tower near the center of town, with no higher building closer than about 200 feet. The motor and transmission are protected from the weather by a close-fitting metal hood. The siren itself cannot be covered and is therefore made of bronze and aluminum, neither of which will corrode. Rain will not affect the siren, and in order that snow may not clog it, a simple roof, flat and smooth on the under side and supported by four posts, is placed over it. This at the same time serves as a reflector for that portion of the sound that ordinarily goes skyward.

If the siren is placed on top of some building not far from the telephone exchange, the power wires can be run to it through the telephone office. The operator can then close the switch and turn in the alarm immediately upon receipt of a telephone call. Other switches can also be located at convenient points, if it is thought necessary or desirable.

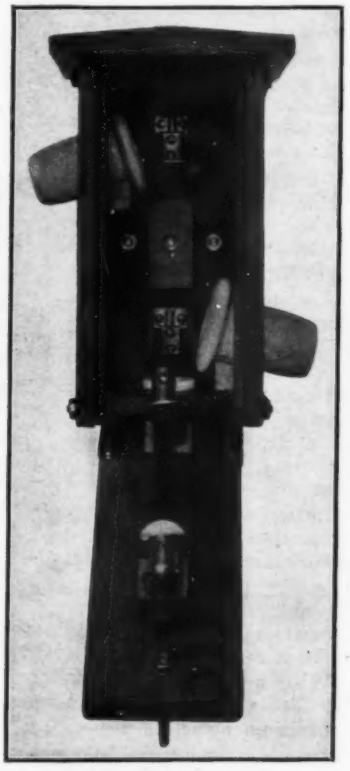
Sound penetration is materially affected by local conditions and it is impossible to determine how much sound may be needed to fulfill indefinite requirements. The Denver siren makes very efficient use of electric power in creating sound, and the three horsepower size is ample for most places. Larger sizes are built to order, the five-horsepower siren creating twice the volume of sound of the three-horsepower size. Both sizes give the same range of pitch. The dimensions of the smaller size outfit are 40 by 20 by 15 inches; its weight complete is 300 pounds.

New Primary Cutouts of Safety Type.

A new line of expulsion-type primary cutouts of improved design has been developed by the General Electric Company, Schenectady, N. Y., for outdoor use. They have standard ratings of 15 and 75 amperes, 6,600 volts or 100 amperes, 2,500 volts.

The main feature of the design is the absolute safety afforded the operator in refusing the cutout. When the door is opened, the fuse-holder is automatically disconnected from the circuit. The ring bolt and latch, with which the door is fitted, are well separated from all live metal parts, so that it is entirely safe to handle.

The boxes are constructed of well seasoned ash, oil-impregnated and further protected from weather conditions by an outside coat of black japan.

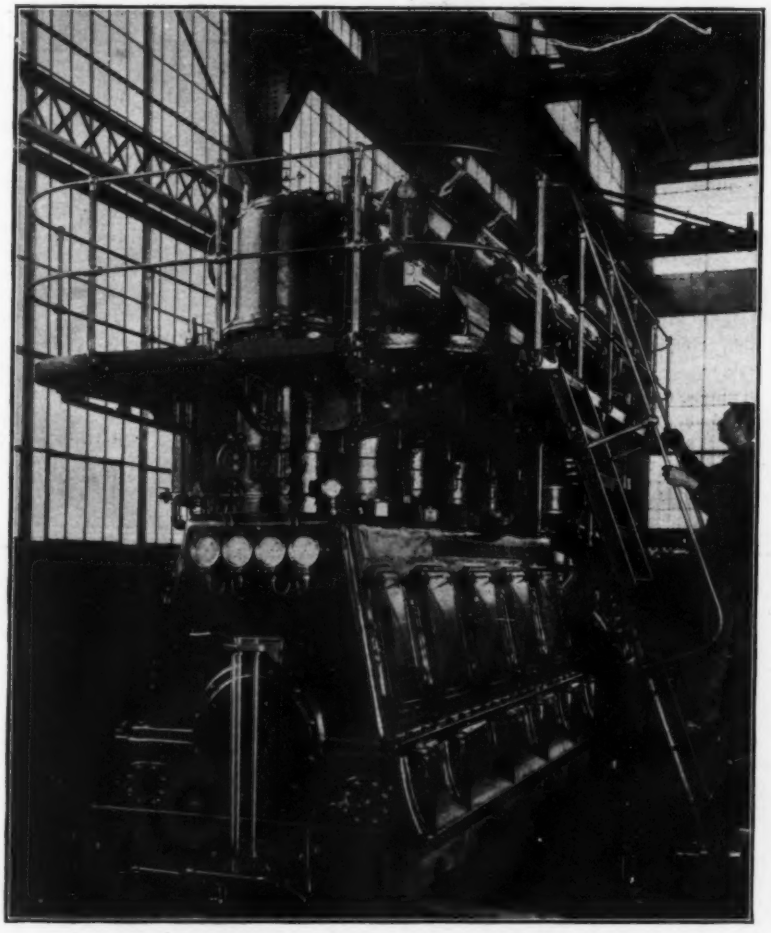


Primary Safety Cutout.

On the bottom of the box is an indicator in the form of a brass card-receiver placed over the gas outlet of the expulsion fuse. Into this receiver can be slipped a white card, a square of oiled paper, or a very thin sheet of white celluloid, forming a white target against the black background of the box that can be readily seen from the ground. The blowing of the fuse causes a discharge of gas from the end, which dislodges the card from its receiver. This feature obviates the necessity of climbing up to ascertain fuse condition.

Large Four-Cylinder Vertical Diesel Engine.

The Busch-Sulzer Brothers-Diesel Engine Company, St. Louis, Mo., has been manufacturing Diesel engines for the past 15 years, during which time its ripe experience has enabled it to produce these very efficient prime movers to meet exactly the conditions of operation and attendance existing in this country. Coupled to this experience has been the skill and engineering ability of its European associates, the firm of Sulzer Brothers, of Switzerland. This combination has played an important part in the general design and the selection of materials, as well as to the finish given to the various parts of the engine. The aim has been continually to make a very substantial and completely reliable unit and one capable of very close speed regulation.



Four-Cylinder Diesel Oil Engine, 500 Brake-Horsepower.

In connection with the Panama-Pacific International Exposition at San Francisco, the company has built and is now installing a 500-horsepower type B engine, in the construction of which it has taken particular care since it is to be an exhibit typical of the highest achievement in the building of Diesel engines. A combined side and front view of this engine is shown in the accompanying illustration.

This engine is of the four-cylinder, single-acting, four-stroke-cycle, inclosed-crank-case, medium-speed, vertical type, a type that is particularly suitable where continuous service and high maintenance of efficiency and general economy in operation are expected. The frame of this machine is said by the manufacturers to be not only more rigid than the A frame but more quiet in operation; it also precludes the possibility of the escape of gas into the engine room when piston rings become worn; the throwing of oil is also eliminated. Despite the compactness of this frame construction every part of the engine is very accessible. The inclosing case can be readily removed to give access to the crankshaft and bearings. The gallery makes every portion of the upper section of the engine immediately accessible. The base of the frame extends a considerable distance below the floor level. This strengthens the base and places the crankshaft very low so as to minimize vibration.

In the photograph herewith, which was taken on the test bed of the company's St. Louis works, the three-stage air compressor is in the foreground and looks like a fifth cylinder on the engine. The compressor is driven from the crankshaft. Special means have been provided for cooling the compressed air between the different stages and after final compression; also means for the extraction of moisture. The air is used for fuel injection.

The camshaft is located on a level with the cylinder heads, which construction eliminates the use of push rods, reduces the number of parts and arranges those parts which should have regular inspection at a convenient height where they may be regularly and readily inspected by the operating engineer.

The governor is at the right-hand end of the engine. Besides controlling the amount of oil delivered by the fuel pump to the various cylinders, it regulates the lift of the needle of the fuel valve and the duration of its opening; it also controls the amount of air compressed by the air compressor. These are the three factors which control the economy of this type of engine and with the type of governor used all of them are automatically regulated by this single mechanism.

Above the governor and directly above the gallery plates is the fuel-pump set, which is one of the things controlled by the governor. There are four levers on the pump, each with two handles; one set extends down below the gallery plates for operation from the floor and the other set extends upward for operation from the gallery. These levers have three positions and control the priming of the fuel system, the starting and the stopping of the fuel flow to the fuel valves. There is a lever for each cylinder and therefore each cylinder may be separately controlled.

The fuel pump group consists really of four separate pumps, the cylinders of which are cast in an integral piece. The pump group is operated by eccentrics from the vertical governor shaft and gives two discharges of fuel for each power stroke of each cylinder, thus affording very accurate speed regulation for any change of load occuring between two working impulses; it also influences the quantity of fuel on the second discharge stroke, thus giving two regulated discharges to the atomizers for each opening of the fuel valves of the cylinders on the combustion stroke of the cycle.

The engine is equipped with a system of forced lubrication operated by a rotary positive-displacement pump,

which contains oil filters in duplicate and also a cooler. Therefore this system not only lubricates the bearings, but cools them at the same time. The oil is fed at a pressure of 30 pounds per square inch and is carried from the main bearings through the shaft to the crankpin bearings and thence through the connecting rods to the wrist pins. A large continuous flow of oil is supplied. The oil is filtered, cooled and used over and over again.

Throughout the design and construction of the engine the highest character of engineering skill and workmanship have been combined. Great care is taken to see that each part is constructed not only so that it functions properly and economically, but that it will continue to do so and give absolute reliability without excessive attention.

Office of Chicago Branch, Indiana Rubber & Insulated Wire Company.

Indiana Rubber & Insulated Wire Company's Chicago Branch.

When F. D. Schwartz took up his new work as western manager of the Indiana Rubber & Insulated Wire Company's branch and warehouse, in Chicago, Ill., he originated a slogan that tersely defines the quality of his company's product: "If it's Paranite, it's Right." He intends to make that slogan known to every user of rubber-covered wires and cables and if his eight years of experience and achievement as city sales manager of the Electric Appliance Company are a criterion, he is bound to succeed.

The new Chicago branch is located at 210 South Desplaines Street. Offices, salesroom and warehouse facilities are provided and the company announces that a stock of Paranite rubber-covered wires and cables large enough to supply usual or even extraordinary demands will always be available in the Chicago branch. The territory under the immediate jurisdiction of the Chicago office embraces all of northwestern Canada and that part of the United States not included in the New England states, New York, Pennsylvania, Delaware, Maryland, and New Jersy.

Although extensive additions have been made to the plant of the Indiana Rubber & Insulated Wire Company, at Jonesboro, Ind., within the past few years, expansion for further manufacturing facilities is needed, and 1915 will witness the completion of plans to handle and market a greatly increased output. At present the plant is working 24 hours per day, so it is apparent that an increase in capacity is needed.

Part of the Wire and Cable Stock in the Chicago Branch of the Indiana Rubber & Insulated Wire Company.

The provincial government of the Island of Tasmania has purchased the partly completed hydroelectric plant at Great Lake and proposes to spend $500,000 at once toward its completion.

Western Electric Company's Annual Electrical Supply Year Book.

The Western Electric Company starts the new year by distributing the first edition of its "1915 Electrical Supply Year Book." This large catalog, for such it is, represents something radically new in the electrical supply field. No jobber has issued a general catalog more frequently than once every three years. It has remained for the Western Electric Company to adopt a definite policy of an annual catalog, which it believes will serve to give the industry at all times the most recent information obtainable on the materials which it supplies.

The book departs from the beaten path in another particular; in place of the manufacturers' list prices, which catalogs of this kind have heretofore invariably carried, this new book announces a complete series of Western Electric list prices upon which a uniform basic discount applies, such a discount indicating to the holder of the catalog his approximate price on all the articles listed. It is significant that at last someone in the electrical field has had the far-sightedness to initiate and the ability to carry out a comprehensive plan of readjusting the present confused price situation in the electrical industry.

It is only a few years ago that the hardware business was carried on under the same unsatisfactory price conditions, i.e., the necessity for the jobber to sell goods from manufacturers' lists, following the manufacturers' wide variety of differing discounts.

In the electrical field it has long been recognized that if the people engaged in the business are ever going to find it reasonably profitable, the cost of operating must be reduced and one of the first places where it has been recognized this cost ought to be

reduced, has been in the simplifying of the method of estimating on material and the purchasing and sale of supplies.

The task of reducing the manufacturers' lists to a uniform jobbing-house list involved a tremendous amount of work. The Western Electric Company has tackled the job and carried it into successful execution. This marks an important step in the development of the electrical jobbing business. The contractor who is called upon to estimate on jobs can now make it unnecessary to refer to one list price and carry in his mind one string of discounts for wire, another for porcelain, another for schedule material, another for fixtures, etc. With the new Western Electric Year Book before him, he can open at any page, apply a uniform discount and arrive at a price which he can safely figure represents his cost, or he can group the quantities of material he needs together with the total list prices applying thereon, and again apply the uniform discount and have a working basis upon which to figure his profits on the job.

The trade will find that the Western Electric Company has overlooked no point toward making this book easy of reference, as well as complete in its listings. Although containing more than 1,260 pages, including an alphabetical index, it probably weighs less than any similar general catalog.

One of the features of the book is a 24-page advertising section embracing examples of advertising and selling helps which the company furnishes to its agents in connection with the sale of goods carrying its familiar trade name. This section of the catalog includes the listing of electrotypes for newspaper advertising, street-car cards, typical window displays, lantern slides, booklets and other literature on fans, motors, vacuum cleaners, washing machines, interphones and electrical household devices of every nature. These helps have been made extensive use of by central stations, dealers and contractors, who have taken advantage of some of the company's well planned selling campaigns, but this is believed to be the first comprehensive collection of the kind which has been gotten together by any manufacturer or jobber.

The production of this catalog establishes the right of the electrical jobber to a place in the industry. In addition to traveling a force of salesmen, maintaining an adequate stock of goods at convenient distributing centers, carrying the credit risk of the retailer, contractor and central station, the jobber may be a real constructive force toward the betterment of conditions in the business.

Westinghouse Electric Developments in the Year 1914.

In spite of the business depression prevalent during the year just passed there has been the customary advance along electrical lines. This progress, however, has been confined to extensions of existing standards and lines rather than any new or startling discoveries or inventions.

Turbogenerators.

The gradually increasing size of generating units has kept apace this year until we now look with the utmost complacency on the installation of a 35,000-kilowatt turbogenerator, whereas a few years ago we marveled at a 10,000-kilowatt set as reaching the limit in the way of size. The growth in size has been a regular and normal one, due entirely to the demand for large and more efficient units, to take care of the rapidly increasing use of electricity in the home, office, store, factory, and farm.

The Westinghouse Electric & Manufacturing Company is installing for Brooklyn Rapid Transit Company the 30,000-kilowatt "double" unit, which has recently been described. Closely akin to the increasing size of the generating units is the continued growth of high-tension voltages for transmission purposes, as exemplified by the Pacific Light & Power Company in California, which uses 150,000 volts. These transformers reported in 1913 still hold the record for a high-voltage commercial installation.

An interesting development in connection with this plant is the use of automatic voltage regulators on both generating and receiving ends, thus maintaining constant potential at both points, the regulators on the latter being used with the synchronous condensers.

Transformers.

Transformers of the self-cooling type are now being built up to 5,000-kilovolt-ampere capacity, of sheet steel equipped with external radiators made oil-tight by oxacetylene welding process. The air-blast transformer has also reached a maximum size in a a 3,500-kilovolt-ampere, single-phase unit in 25-cycle service.

A new development is the portable transformer substation, consisting of a car 10 feet wide by 35 feet long, having mounted thereon three oil-insulated, self-cooled transformers with high-tension and low-tension switching equipment, and having a capacity of 4,000 kilovolt-amperes. This compact arrangement is made possible by a forced draft through ducts around the base of the transformers.

Electric Drive.

One of the most interesting applications of electrical machinery within the past year, and which has proven its economy and efficiency, is that of driving rolls in sugar mills by means of electric motor power. Not only has the apparatus for this method of drive been cheaper than the Corliss engines formerly used, but installation costs have been less. It has been more economical in operation; expense in point of attendance and oil has been less, and annual charges heretofore necessary to completely disassemble, overhaul and reassemble the engines eliminated. The operators have also gained greater control, and are in a position to better and more quickly vary the speed of the rolls, thus practically guaranteeing continuous service.

The use of electricity in steel mills has continued. A number of large direct-current motors have been connected to the rolls for producing hoops by the Sharon Steel Hoop Company, this class of work having previously been performed by alternating-current motors.

A number of steel companies have installed electric furnaces, indicating an appreciation on their part of the ease of application and accurate control, as well as other advantages of this later electrical development.

A particularly noticeable fact is the adoption of central-station power by the steel mills, coal companies and railroads for work in their respective lines, the latter two particularly for work at the terminals. The Westinghouse company alone, at a rough estimate, has furnished equipment during the past year that will result in 1915 in an output by central stations of 15,000,000 to 20,000,000 kilowatt-hours of energy for this class of service, assuming normal business conditions.

During the past year the railroads, steel foundries, steel mills, and machine shops, in particular, have taken quite an active interest in the subject of arc welding. A very considerable saving is effected by its use, and the advantages of this apparatus are just beginning to be appreciated. Undoubtedly there is still a wider field for its use. The Westinghouse company has been actively engaged in the development of this proposition, and has furnished approximately two-thirds of the welding equipment installed during the past year, the railroads at the present time being the principal users.

In industrial lines the development has been mainly along the lines of refinement, particularly in reference to the control, the Westinghouse company during the past year having brought out alternating and direct-current magnet switches, automatic starters, and controllers for use with various industrial applications, and improvements in reversing-motor planer equipments. The company has also

extended its lines of industrial motors, including the polyphase and single-phase types, elevator motors, blowers of the Ventura type, and direct traction elevator motor and control, which latter is meeting with marked success.

Relays and Circuit-Breakers.

In the case of switchboards progress has been made in the protection of circuits by means of improvements in relays and circuit-breakers. An induction type relay operating on watt-hour meter principles, that obviates troubles experienced with the bellows type, has been brought out. This relay has a self-contained torque compensator giving inverse-time-element on ordinary overloads, and definite-time-element on heavy overloads, or short-circuits.

A direct trip attachment has also been developed so that a circuit-closing relay of this type can be used with a circuit-breaker tripped from a current transformer, where no shunt trip circuit is available. This attachment, which can be built for circuit-breakers already installed, consists of an auxiliary magnet, which prevents the tripping plunger of the circuit-breaker from operating until the relay contacts close.

In the design of oil circuit-breakers themselves no very great changes have occurred, but the year has seen much progress along the lines of following out the great improvements which were commenced during 1913. The principal advance has been in the use of one-piece cylindrical tanks with round bottoms for circuit-breakers of heavy capacity, this obviously being the very strongest type of tank which it is possible to obtain.

During 1914 several 24,000-ampere carbon-type circuit-breakers were put into service, these being the largest capacity circuit-breakers of any kind ever built.

Outdoor oil circuit-breakers can now be obtained for any voltage from 13,200 to 165,000, electrically operated, at reasonable prices, and in entirely self-contained units for automatic operation, and at the lower voltages with self-contained inverse-time-limit overload.

Meters.

The introduction of the reactive-factor meter in place of the power-factor meter, in other words, the use of a meter to measure the sine of the angle of lag or lead instead of the cosine, was made during the year. The meter is the same in principle as the power-factor meter, but it enables operators to keep the power-factor closer to unity than can be done with the older instrument.

A distinct advance has been made in metering electric energy by the introduction of a watt-hour demand meter, thus catering to the demand of users of electric rates who insist on including the demand as well as kilowatt-hours consumed. The Westinghouse company has brought out a demand meter that has neither clock, motor, nor timing device, contacts or solenoids. It is self-contained, and of about the same size as an ordinary meter, and contains a secondary disk, in the same magnetic field as the main disk, which is controlled by an escapement wheel and cog. A pointer connected thereto indicates the highest watt-hour demand for the given period of time.

A fault-localizer just brought out, new in application, but not new in principle, permits the ready and exact location of a ground in a cable circuit. It is a combination of a galvanometer and resistances, forming a conveniently operated bridge for determining the location of the fault.

Rotary Converters.

Continued use of commutating poles on rotary converters has proved their usefulness. A 4,000-kilowatt, 600-volt, 25-cycle converter is now being built for the Interborough Rapid Transit Company in New York, with a 300 per cent momentary overload guarantee. A 2,000-kilowatt, 270-volt, 60-cycle synchronous booster rotary is now being built for the Cleveland Electric Illuminating Company, which will be the largest 60-cycle rotary of this type ever built.

The most notable feature about the above developments is the comparatively higher speeds that have been used over those formerly used. The use of commutating poles in the design of these machines has made not only this higher speed possible, but has produced better machines, it being particularly noted that the peripheral speeds of these machines are very little, if any, higher than the peripheral speeds used on the non-commutating-pole designs.

Compensated windings have been effectively used in addition to commutating poles on generators, where subjected to very severe peak loads, such as in large flywheel motor-generator sets.

A new line of constant-current transformers for series arc lamps and incandescent lamps has also been brought out by the Westinghouse company.

Lamps and Fixtures.

Possibly one of the most pronounced developments of the year has been the increased use of Mazda lamps for street-lighting purposes. Until recent years the arc lamp had a monopoly of the street-lighting field. It has labored under the disadvantage of a rather high upkeep, the necessity for recarboning and a somewhat flickering light. All of these shortcomings are overcome by the Mazda lamp, whose advantages are sufficient to have caused it to be used to a very considerable extent for street-lighting purposes, and its popularity in this use appears to be extending rapidly.

This has led to the adoption of a new fixture for use with these new street-lighting units, a complete line bearing the trade name "Luxsolite," for both multiple and series Mazda lamps, having been brought out during the year.

Appliances.

The use of domestic devices has continued with increased popularity, and no startling innovations have been brought out, but rather a general improvement and extension of existing lines. Among the improvements made by the Westinghouse company during the year may be mentioned a new five-cup coffee percolator, thus bringing this useful device into the reach of practically every one having electric service; an electric curling iron; a new electric iron with an efficient detachable rear connection giving perfect contact; an improved type of non-luminous heater; an electric linotype pot for heating type metal for linotype machines, eliminating the objections of gas, gasoline or kerosene heaters for this service, and adding a new source of power for central-station development.

Electricity on Gasoline Automobiles.

The use of electricity in the automobile is one of the modern developments which has grown rapidly. At first the only use that electricity found in the automobile was for purposes of ignition. However, the convenience of electricity has won over the automobile field in a remarkable manner in the past few years. In these modern days no automobile is complete unless the gas-engine charges are electrically ignited, and it is equipped with electric lights, and an electric motor for starting the engine, and electric devices for shifting the gears, and doing many of the things which formerly were done by some other means.

These, of course, are not entirely developments of the past year, but the past year has shown its fair share of the refinements in this particular development. The single machine, with a single armature and single commutator, which may be used either as a motor for starting the engine or as a generator for charging the storage battery, is a development of the year. Further, the idea of making the electric unit entirely self-contained is one of this year, as a self-contained unit has been produced which comprises a motor, a generator, a distributor, and the necessary induction coils, etc., for the ignition. Another development is the magnetic pinion shift, wherein the

starting motor is thrown into gear by means of a magnetic device, instead of a manually operated device, as in previous years. It is surprising how completely the electrical equipment has won over the automobile field in recent years. There seems to be no question but what electricity not only has come to stay, with the automobile, but has come to be developed to a much larger degree in the future of this vehicle.

Railway Apparatus.

The year 1913 saw the adoption of the split-phase system for the electric locomotives on the Elkhorn-Bluefield electrification of the Norfolk & Western Railway Company. The year 1914 saw the reduction to practice of the system and the actual construction of the locomotives. A trial locomotive was first built, and proved thoroughly satisfactory, and shipment of the final locomotives is under way.

The development of the split-phase locomotive referred to above has led to the development of a control quite different from that ordinarily employed in connection with heavy traction equipments. The most unique feature of the control is the liquid rheostats, which provide for an exceptionally smooth acceleration, regardless of the size of the train, and at the same time provide a ready means for the balancing of load between units having drivers of slightly different diameters.

The electrification of the main line of the Pennsylvania from Philadelphia to Paoli is rapidly approaching completion. This single-phase installation is a very important step in the railway field.

The year 1914 is also notable for the demonstration of the practical operating characteristics of the metal rectifier, as developed by the Westinghouse Electric & Manufacturing Company. With the co-operation of the Pennsylvania Railroad, a combination baggage and passenger car was equipped with rectifiers and direct-current motors of 1,000 horsepower total capacity. After satisfactory preliminary operation on the test track at East Pittsburgh, extended tests were undertaken on the New York, New Haven & Hartford Railroad, the object being to determine the effect of sustained operation at high voltage, durability of units under service conditions, influence of large capacity systems, etc. This car has been operated over 20,000 miles satisfactorily, and is at present hauling a train in revenue service on the New Haven road on a schedule calling for 240 miles per day.

In direct-current railway-motor construction, a development promising great advance has been inaugurated in the shape of a 40 to 50 horsepower motor with a pressed-steel frame. This has attracted such widespread attention that it is necessary only to mention it in this connection. This pressed-steel frame is only one of a number of applications of pressed steel in railway-motor design which have been undertaken during the year.

The great popularity of the small-wheel motors previously developed led to the bringing out of a 40-horsepower motor with lower armature speed, designed to operate with the 26-inch wheel. Split motors have been greatly improved by the production of a design employing through bolts for securing the housings into the frames. The single-phase motor design has been improved by the introduction of motors without resistance leads, and with simple control.

Experimental motors and control for operation in connection with high-voltage direct-current distribution systems have been developed. An equipment was tested at various potentials up to as high as 7,000 volts, with very satisfactory test results. In this connection it is interesting to note that there have been a number of extensions to existing 1,200 and 1,500-volt roads, as well as some new roads which have been electrified on this basis.

During the past year there have been numerous applications of the pneumatically operated drum-type control, already well known to the trade as type "PK" control. A modified form of the "PK" control has been employed in connection with 200 equipments, which will be operated in the new New York municipal subway. In this connection it is interesting to note that these equipments will be supplied with automatic train-line couplers operating storage-battery control circuits, which are at a potential of 32 volts from ground. The low-voltage train control offers the best protection against the development of grounds, and insures the most complete control of the train at all times.

The last year has marked the application of numerous type "AB" control equipments, both for elevated, subway, and steam railroad electrifications. The adoption of this type of control appears to be a step toward the use of automatic train-line couplers.

In small locomotives the bar-steel frame has increased in favor, and is now standard on mine and industrial locomotives up to and including 18 tons. Storage-battery locomotives, also for mine and industrial service, have been standardized to and including six tons. Sleeve-type armature bearings of bronze continue to give such excellent results that the extensive application of anti-friction bearings is still unjustifiable. Flexible gears have been adopted by large operating companies as standard, and wide application of this type of gearing is looked for. A considerable advance has been made in railway gearing, and forged gears have received very wide application. The tendency of the times is toward a higher grade of gearing, and in line with this tendency the type "BP" gear has been adopted as standard. Oil-ring bearings have been introduced on large locomotives for armature bearings, and give promise of very satisfactory results.

Overhead line construction has been developed in many respects, and the problem of current collection has received a great deal of study. The double-shoe pantograph trolley, developed in 1913, has been run in test service, and an entirely new record set in the collection of current at high speed. With this trolley it is now possible, under favorable conditions, to collect 2,000 amperes at 60 miles per hour from a double trolley line.

Western Electric Developments in 1914.

Progress, in the familiar commercial applications of electricity, necessitates the development of new apparatus and the redesigning of old apparatus to meet the new requirements. The Western Electric Company during 1914 made a number of new and important developments in electrical apparatus, of which the following is a resume:

Telephone Apparatus.

The use of the standard package idea, as adapted to Interphone outfits, has been extended to include in all, four different combinations. The No. 14 outfit includes two wooden wall-type Interphones, and the No. 15 two of the hand-set type. Interior and outside wiring outfits are packed with everything needed to put up the Interphones. Complete illustrated installing directions are furnished with all outfits.

The No. 16-A Interphone outfit, consisting of two hand sets and installing material, is intended primarily for use in business offices and shops where there is already a bell, buzzer or annunciator system in operation. To install this outfit it is not necessary to run any new wiring. No. 16-B outfits, containing one hand set, are also provided for use, in addition to a No. 16-A outfit for use on existing bell, buzzer or annunciator system having more than one push button, or where it is not desired to install hand sets at more than one point communicating with the buzzer or annunciator station.

The No. 17 Interphone outfit consists of two hand-set Interphones, two bells and installing material. This outfit, when installed, provides for two-way

ringing over two wires, for which two batteries are required at each end of the line. It is intended for use in homes or offices.

A new desk stand for intercommunicating service has recently been placed on the market for use in five and nine-station Interphone systems. This new desk stand, known as the No. 6034 type, has ringing buttons in the base, and eliminates the extra push-button block that has heretofore been necessary, thus producing a more compact and convenient equipment. The desk stand is of the familiar Western Electric type, finished in durable black.

Switchboards.

A new type of equipment for central-battery central offices has been developed and placed on the market, after the successful termination of a number of trial installations. This switchboard equipment gives a form of semi-automatic operation, by making use of an automatic ringing and automatic listening feature. Automatic ringing enables the operator, by merely plugging into the called-for subscriber's jack, to ring the latter's telephone bell automatically at regular intervals until the subscriber answers. The automatic listening feature eliminates the necessity for operating a listening key, the circuit being so arranged that the operator's telephone set is connected to the calling subscriber's line as soon as the operator plugs into the answering jack. A distinctive feature is found in the fact that it is impossible to ring in the called-for subscriber's ear, as ringing current is cut off by a tripping relay, either during the ringing or the silent interval, the instant the called-for subscriber takes the receiver from the hook. Other features embodied in this equipment are the facilities for automatic peg-count and automatic recall, whereby either one of the talking parties can, by means of automatically operated apparatus, instantly call the operator on the line without depending upon the form of supervisory signals now in general use.

A new automatic ringing mechanism has been developed for use with these automatic ringing and listening equipments. This mechanism, which is used to produce the ringing and silent intervals, is of the clockwork type, making use of a high grade, reliable clock movement. This type of machine is simple in design, and as trustworthy as a motor-driven ringing machine and interrupter. In order to maintain the minimum load on the apparatus that produces the ringing current the mechanism is so arranged that only one-third of the switchboard is connected to the ringing current at any one time. This makes it possible to serve a greater number of switchboard positions than if all positions were ringing on the same interval.

As a further development in standardizing switchboard equipment a universal type of multiple switchboard section has been produced. This can be used for any one of the following varieties of equipment: Common-battery multiple; common-battery partial multiple; common-battery multiple or partial multiple without answering jacks; lamp-signal magneto multiple; lamp-signal magneto convertible; magneto multiple or partial multiple using combined jacks and signals. By standardizing frameworks in this manner great flexibility is obtained. Equipments, in many cases, can be readily adapted to the various requirements prevailing in the telephone operating field.

On magneto equipment making use of combined jacks and signals the latter are mounted 10 per strip on newly devised punched mountings. These mountings are arranged to mount from the back of the board, as in the case of multiple jacks and answering-jack lamp sockets, and produce a more flexible and better appearing switchboard equipment.

Mine Telephones.

Development work in this important branch of the telephone art has been confined to the perfection of the mine rescue telephone equipment. This equipment, which provides a reliable and flexible means of constant communication between a rescue party in the mine and a directing party at the surface, has been developed in collaboration with the Federal Bureau of Mines. The final design is such that it will meet successfully all the conditions that may arise in mine rescue work.

With the new equipment it is possible for a rescue party of from one to five men to be connected to the circuit at the same time. The throat transmitter does not interfere with the use of standard oxygen helmet, and a high grade of transmission is obtained, even with all five sets in use, and all the coils of wire cut in, making a total transmission line of 3,300 feet.

Railway Telephones.

An efficient loud-speaking telephone for railway train-dispatching work has been produced, after considerable development work. The present Western Electric loud-speaking telephone is unique, in that it has both of the essential qualities of clear enunciation and large volume. Service installations have already been made on the lines of two large railroad systems. The loud-speakers are used at the train dispatcher's office and way stations, instead of head receivers. This relieves the operator of the necessity of wearing a telephone instrument continuously, and during thunderstorms or other electrical disturbances, prevents the troublesome static noises from reaching the operators' ears.

A mechanically held selector has been developed for way-station signaling service. This is a group type selector, which does not require current during the ringing period, after it has once been operated. This is of considerable advantage in simplexing lines, and, furthermore, produces a saving of battery current.

A convenient type of milliammeter and voltmeter small enough to be slipped into a coat pocket is available for line testing. The instrument is furnished in a substantial black finished case, and has screw type terminals. Accuracy is assured by careful calibration of the meter scale.

Generators for Telephone Currents.

There is now on the market a three-bar generator known as the No. 50 type, that is sufficiently powerful to operate 10 to 30 telephones connected to a line 5 to 20 miles long, and its cost is such that it is economical for use on moderately loaded lines. This generator, which is furnished in the No. 1317 magneto telephone, embodies the same type of construction as the familiar No. 48 five-bar generator, and is equally as durable. It is not unnecessarily powerful, but furnishes all the energy that ordinary service demands. Tests have shown that it may be used on 90 per cent of the magneto lines now equipped with five-bar magnet generator sets, and perform its functions satisfactorily.

Relays.

A new supervisory relay, the No. 200 type, similar in many respects to the well known No. 194 type line and cut-off relay, is now available for switchboard equipment. The No. 200 relay is one of the most sensitive supervisory relays yet developed, its construction permitting of a greater winding space than former types. The armature is "U" shaped, the old style knife-edge variety of armature having been discarded, as in the No. 194 type relay. A micrometer adjusting screw permits of accurate adjustment. Every part of the relay is accessible for inspection.

Vacuum Cleaners.

A bag-on-the-handle type of electrically operated vacuum cleaner has been added to the line of Western Electric portables. This new cleaner is known as the No. 11, and is intended for small houses and apartments. It embodies many new and distinctive features, among them a novel device for picking up threads, a controlling switch conveniently located under the

right hand of the operator, and a horizontal handle that also serves as a means for hanging the machine away in a closet. The dust bag, which is securely supported on the framework and does not hang loosely, is of ample capacity and easily emptied. The cleaner is of sufficient power to be used with an extension hose and separate tool.

Further development work on the horizontal type of stationary vacuum cleaner has resulted in the production of cleaners having capacities up to and including 10 horsepower. The largest size is capable of cleaning very large buildings.

A serviceable and efficient washing and wringing machine, placed on the market during the year, has already met with a great deal of favor. Every moving part of this machine is enclosed. No belts or chains are used, as the motor is direct connected to the moving parts by a worm-gear shaft drive.

The machine itself is made with a rustproof metal lining and a metal tub that will not warp. The wringer rolls have a safety release, while only two levers are needed for operating both washer and wringer. The cost of operation is remarkably low.

Latest Approved Fittings

The electrical fittings illustrated and described in this department have been approved by the Underwriters' Laboratories, Incorporated, following examination and tests conducted under standards of the National Electrical Code as recommended by the National Fire Protection Association.

ATTACHMENT PLUGS, Fuseless. —Tregoning Electric Manufacturing Company, 318 Prospect Avenue, N. W., Cleveland, O.

"Tregoning", 660 watts, 250 volts.

Separable-cap attachment plugs.

Composition cap, catalog Nos. 219, 223.

Porcelain cap, catalog Nos. 220, 221.

Non-separable attachment plugs.

Catalog Nos. 225-28 inclusive.

Approved December 7, 1914.

CABINETS. — Electric Operations Company, 254 Thirty-sixth Street, Brooklyn, N. Y.

Cabinets shown by tests and examinations conducted by Underwriters' Laboratories to be in accordance with requirements of National Board of Fire Underwriters, have labels attached.

Approved December 2, 1914.

CIRCUIT-BREAKERS. — Condit Electrical Manufacturing Company, 293 Franklin Street, Boston, Mass.

Type CC, 50 amperes, 600 volts.

Approved December 7, 1914.

FASTENERS.—Machen & Mayer Electrical Manufacturing Company, Twenty-first Street and Fairmount Avenue, Philadelphia, Pa.

Fastener, catalog No. 7026, for securing flexible tubing in end openings of switch boxes. Brass-plated steel yoke with curved edges for gripping tubing at each end coinciding with end openings in box and secured by screw through center threading into back of box.

Standard for use only with switch boxes of this manufacturer.

Approved December 2, 1914.

FUSES, Cartridge Enclosed.—Metropolitan Engineering Company, 1250 Atlantic Avenue, Brooklyn, N. Y.

"Metropolitan" cartridge enclosed fuses, 61-100 amperes, 250 volts.

Approved December 2, 1914.

HEATERS, Electric.—The Dover Manufacturing Company, Canal Dover, O.

"A-Best-O" electric flatiron; catalog No. 6½L; 5 amperes, 110 volts. This iron has adjustable thermostat for maintaining constant temperature, and is supplied with sheet-steel stand.

Approved December 2, 1914.

RECEPTACLES, Standard.—General Electric Company, Schenectady, N. Y.

"G. E." wall sockets, brass-shell.

Key, 250 watts, 250 volts, catalog No. GE282.

Key, 660 watts, 250 volts, catalog Nos. GE414-21 inclusive.

Keyless, 660 watts, 250 volts, catalog Nos. GE019, GE263, GE264.

Keyless, 1500 watts, 250 volts, catalog Nos. GE521-24 inclusive.

Approved December 3, 1914.

RECEPTACLES, Standard.—Pass & Seymour, Incorporated, Solvay, N. Y.

"P. & S." brass-shell, closed or slotted bases.

Key, 250 watts, 250 volts.

Cleat, catalog No. 807.

Concealed, catalog Nos. 808, 809, 811, 812, 817.

Conduit box, catalog Nos. 805, 806, 813, 815.

For use on metal ceilings, catalog Nos. 814, 816.

Molding catalog No. 819.

Pull, 250 watts, 250 volts.

Conduit box, catalog No. 428.

Also above types with shade-holders attached; key type with composition or insulated metal key, or with "Shurlok" attachment.

Approved December 3, 1914.

RECEPTACLES, Weatherproof.—E. H. Freeman Electric Company, Trenton, N. J.

"Circle F", 660 watts, 250 volts.

Conduit box, catalog No. 269 (with rubber gasket).

Approved November 19, 1914.

SOCKETS, Standard. — Benjamin Electric Manufacturing Company, 128 South Sangamon Street, Chicago, Ill.

"Benjamin" porcelain-shell.

Keyless, 660 watts, 600 volts. Twin outlet, catalog Nos. 424-27 inclusive, 424½, 425½.

Approved December 3, 1914.

SWITCHES, Automatic. — Detroit Time Switch Company, 118 Kenilworth Avenue, Detroit, Mich.

Automatic time switch, 20 and 30 amperes, 250 volts.

This device consists of cast-iron case inclosing eight-day clock mechanism, arranged to operate double-pole labeled snap switch.

Approved December 2, 1914.

SWITCHES, Knife. — The Bryant Electric Company, Bridgeport, Conn.

"Bryant" or "Perkins".

Type "A," 1, 2 and 3-pole, all capacities, 250 and 600 volts; 4-pole, 60, 100 and 200 amperes, 250 volts.

Approved December 3, 1914.

WASHING MACHINE. — Capital Electric Company, 321 North Sheldon Street, Chicago, Ill.

"Capital Safety First Electric Washer".

This device is a portable motor-driven washing machine and wringer with all operating parts, except wringer rolls, inclosed. Under severe conditions of service, input to motor may reach 600 watts. Motors are rated at 110 volts and are supplied in either direct or alternating-current types.

As rating of ordinary key and pull sockets is 250 watts, 250 volts, and this rating is not to be interpreted to permit use at any voltage of the current above 2.5 amperes, device described above should not be used in connection with such sockets.

Approved December 3, 1914.

WELDING MACHINES.—The Winfield Electric Welding Machine Company, Warren, O.

"Winfield" electric welding machine, 7-50 kilovolt-amperes, 110-220 or 440 volts.

Types S and B.

These machines are used to effect union of pieces of metal by compression, after softening by heat produced electrically.

Approved December 1, 1914.

Current Electrical News

ATLANTIC STATES.

WORCESTER, MASS.—The Worcester Electric Light Company has been granted authority to issue 1,000 shares of additional stock, at $200 per share, to cancel notes issued and to meet the cost of enlargements of plant and additions to the distributing system. Address general manager.

DAYTON, VA.—An election is to be held on January 19, 1915, to vote on $30,000 electric light, sewer and water works bonds. Address mayor.

CHESTER, W. VA.—The city clerk has been directed to advertise for bids for a municipal electric plant. Address Councilman Cunningham.

WHITEVILLE, N. C.—An electric lighting system will be installed. Address H. D. McNair, of Maxton.

NORTH CENTRAL STATES.

SALEM, O.—The city may construct a $15,000 municipal light plant.

YOUNGSTOWN, O.—Work on a new light, heat and power plant is to be started immediately by the Mahoning County Light Company. The State Utilities Commission has granted the company permission to issue 20-year six per cent bonds to the amount of $600,000, and $400,000 of stock at par. M. Liebel, former mayor of Erie, Pa., is president of the company which intends to bid for the new municipal light contract.

INDIANAPOLIS, IND.—The Merchants Heat and Light Company has increased its capital stock from $1,500,000 to $2,000,000, all of the issue being common stock.

FAIRBURY, ILL.—A municipal lighting plant will be installed here. Address city clerk.

HARTSBURG, ILL.—A special meeting of the town board will be held soon and the question of lighting the streets with electric lights will be decided.

LEBANON, ILL.—A cluster light system throughout the business district will be installed in this city, plans are being prepared by Prof. A. M. Topping of Purdue University, Lafayette, Ind.

FREEMONT, MICH.—A special election is to be held on January 4 to decide whether to give the Grand Rapids-Muskegon Power Company a lighting franchise and to sell this company the municipal wiring system for $13,000.

BELOIT, WIS.—The city will install boulevard lights in business district. Address city clerk.

ST. PAUL, MINN.—The New Brighton Electric Company, a firm which is to manufacture electricity for power purposes, heating and lighting, and to operate a telephone business, filed articles of incorporation with the secretary of state December 23. The company is capitalized at $10,000. The incorporators are Fred Jesner, W. M. James, F. M. Searles, James E. Treat, and J. W. Jandell, all of New Brighton, Minn X.

SOUTH CENTRAL STATES.

BRANDENBURG, KY.—W. D. Coleman, owner of a water power plant at Doe Run, near here, has bought the twenty-year electric light and power franchise sold by Mayor H. C. Woodson. Mr. Coleman is equipping his plant to supply electric service and says that modern machinery will be installed throughout and that day and night service will be supplied.

LEXINGTON, KY.—Extra lights provided for in the city ordinance presented to the City Commission call for an increased annual expenditure for street lighting of $1,250.

PRINCETON, KY.—The city has refused the proposal of the Princeton Electric Light and Power Company to supply lights for the streets at the rate of $125 a month, which is about half of the rate that has been charged. The town has been in darkness for several weeks and it is not expected that service will be resumed until the suit is settled.

FAIRLAND, OKLA.—The Fairland Light and Power Company is planning to install 35-horsepower and 45-horsepower boilers, switchboard, four kilowatt, 110-volt, direct-current exciter, five transformers, two lightning arresters and two meters. Address Floyd Roberts, superintendent.

RED ROCK, OKLA.—The city will construct an electric lighting system. The plans and supervision of construction are under the direction of the Benham Engineering Company, 435 American National Bank Building, Oklahoma City.

CONROE, TEX.—The plant of the Conroe Gin, Ice, Light & Power Company which was recently destroyed by fire will be rebuilt. D.

DALLAS, TEX.—The Dallas Automatic Telephone Company will spend $200,000 in improved equipment, labor and construction within 90 days after the first of the year. Address Clarence E. Linz, vice-president.

GAYLORD, TEX.—The amount of $7,000 is to be expended for a lighting system. Address town clerk.

LONGVIEW, TEX.—The Longview Ice and Light Company has increased its capital stock from $50,000 to $75,000.

WESTERN STATES.

GLASGOW, MONT.—A modern lighting system will be installed here this year by the city. Address S. C. Moore, secretary of Glasgow Commercial Club.

LUSK, WYO.—$8,000 in bonds have been voted to build an electric lighting plant. Address town clerk.

GUANACEVI (DURANGO), MEXICO.—The Mexican Consolidated Mining and Milling Company plans to build an electric power plant at its mines here. D.

TACOMA, WASH.—The city council has ordered Electrical Superintendent Collins to prepare an estimate of replacing the electric transmission lines on the east side of Commerce Street, and of putting the transmission lines underground. This work will be ordered by the council around the first of the year, according to reports. O.

BAKER, ORE.—L. R. Stockman has been engaged to prepare plans for a municipal lighting plant, bonds in the sum of $180,000 for the construction of which will soon be voted upon. J. R. Stannard is consulting engineer.

DALLAS, ORE.—The lighting system of Dallas is to be entirely changed. An ordinance was introduced at the last meeting of the City Council to do away with the arc lights now being used and use instead alternating-current tungsten lamps, with hoods and reflectors. In addition to the 100-candlepower lamps and the ornamental post lighting, the business district will be provided with several 600-candlepower tungsten lamps. Address A. L. Martin, manager of the Oregon Power Company.

GOLD HILL, ORE.—The city has advertised for bids for installing a lighting system and supplying power for a period of 10 years. Bids must be received by January 11.

MEDFORD, ORE.—This city is considering a proposition recently submitted by the Rogue River Public Service Corporation whereby the corporation has agreed to furnish electricity on a wholesale basis to the city, which, in turn, could retail it to city customers. The city will furnish and install wire and poles for transmission lines. O.

LOS ANGELES, CAL.—An ordinance has been passed declaring the intention of the city council to order the installation of an ornamental lighting system on Olive Street between Sixth and Pico Streets.

RED BLUFF, CAL.—A petition has been presented to the city trustees for a street lighting system for Main Street. Address City Engineer Luning.

SAN DIEGO, CAL.—The city council has authorized superintendent of finance, Otto M. Schmidt, to proceed with the installation of electric arches to illuminate Broadway from Atlantic to Twelfth Street and Fifth Street from L to Laurel. The work will be directed by D. M. Crist, of the city engineer's office, in charge of lighting.

VICTORVILLE, CAL.—G. H. Ghrist has sold his interest in the Victorville Electric Light and Power Company to the Southern Sierra Power Company, which will proceed at once to install a system of street lights here.

PROPOSALS.

ELECTRIC FREIGHT ELEVATOR.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until January 22, 1915, for the installation complete of an electric freight elevator in the United States appraiser's stores at Milwaukee, Wis., in accordance with drawing and specification, copies of which may be had at the office of the Supervising Architect, Washington, D. C.

ELEVATOR.—Sealed proposals will be received at the office of the Supervising Architect, Washington, D. C., until January 15, 1915, for the installation, complete, of an electric freight elevator, etc., in the United States post office and court house at Manchester, N. H., in accordance with the drawing and specification, copies of which may be had at the office of the supervising architect.

FOREIGN TRADE OPPORTUNITIES.

[Addresses may be obtained by writing (mentioning file number) to the Bureau of Foreign and Domestic Commerce, Washington, D. C., or to the nearest of its branches at Boston, New York, Atlanta, Chicago, New Orleans, Seattle and San Francisco.]

NO. 14,889. ELECTRICAL HOUSEHOLD APPLIANCES, ETC.—An American consular officer in Asia Minor reports the names and addresses of dealers in his district who are in the market for electric household appliances, such as fans, irons, heaters, table and hanging lamps, brackets, bulbs, wire, sockets, kitchen utensils, meat choppers, small coffee grinders and percolators, etc.

NO. 14,899. ARC-LAMP GLOBES, ETC.—A consul reports that an importing firm is desirous of purchasing arc-lamp globes, electric cables, and electric-light accessories. Illustrations of the arc-lamp globes desired accompanied the report and may be examined at the Bureau and its branch offices.

NO. 14,925. SHIPS' ELECTRICAL APPLIANCES, ETC.—An American consular officer in a neutral country has transmitted a request from a government agent for immediate offers of ships' electrical appliances, submarine mines, torpedoes, blankets, etc. A copy of the full report may be had on application to the Bureau or its branch offices.

NEW INCORPORATIONS.

SALEM, W. VA.—The Salem Electric Light Company has been incorporated with a capital of $25,000 by W. F. Meredith and others.

PASADENA, CAL.—The Pasadena Electric Welding Company has been incorporated here with a capital of $250,000, by Hugo Thornblade, W. A. Glench and S. F. McRae.

CHICAGO, ILL.—Edwards Lighting & Fixture Company, to manufacture and deal in electric and gas fixtures. Capital $25,000. Incorporators: L. J. Georgen, J. L. Cushing and L. V. Hult.

DOVER, DEL.—A charter has been filed with the State Department for the Williamson Johnston Company of McKeesport, Pa. The company is capitalized at $50,000, and is to manufacture and install, and to deal and trade in all kinds of electric appliances. The incorporators are George H. Williamson, Albert T. Johnston and Herman Marwitz, all of McKeesport, Pa.

FINANCIAL NOTES.

The Fort Worth Power and Light Company has sold $64,000 of its 20-year first five-per-cent bonds to Harris, Forbes & Company, of New York City. Bonds mature August 1, 1931, and are part of an authorized issue of $10,000,000, of which $2,412,000, including the present amount, have been issued.

The Texas Power & Light Company has sold to Harris, Forbes & Company and Perry, Coffin & Burr, of New York City, $700,000 of its 25-year first five-per-cent bonds, due June 1, 1937. Bonds are part of an authorized issue of $30,000,000, of which $5,490,000 have been issued, including the present issue, and are being offered for subscription at 91 and interest.

The $425,500 five-per-cent six-year coupon notes of Westinghouse Electric & Manufacturing Company, due January 1, 1915, together with interest thereon, payable at the office of the company, will be paid at the Chase National Bank, New York City, on presentation and surrender with coupons attached. The interest due January 1 on the remainder of the same issue will be paid at the same time and place.

It is stated that new financing in connection with the New England Power system is under way in the form of an issue of $600,000 three-year six-per-cent notes. They are dated November 1, 1914, and are part of an authorized $700,000. Proceeds will be used to pay for permanent additions and extensions which the company has made to its property and for acquiring six-per-cent notes of allied companies. The new issue is additional to $3,500,000 five-per-cent 40-year bonds, $2,500,000 six-per-cent cumulative preferred stock and $2,500,000 common stock previously issued by the New England Power Company of Massachusetts, and is guaranteed principal and interest by New England Power Company of Maine.

Dividends.

	Term.	Rate.	Payable.
Am. Pr. & Lt., uf.	Q	1.5 %	Jan. 2
Am. Pub. Util., pf.	Q	1.5 %	Jan. 1
Cent. & So. Am. Tel.	Q	1.5 %	Jan. 8
Dom. Pr. Transm., pf.	S-A	3.5 %	Jan. 15
Mexican Tel.	Q	2.5 %	Jan. 15
Trinidad Elec. Ltd.	Q	1.25%	Jan. 10
West'gh'e El. & Mfg., com.	Q	1 %	Jan. 30
West'gh'e El. & Mfg., pf.	Q	1.75%	Jan. 15
Y. & Ohio R. R. R., pf.	—	1 %	Dec. 31

Reports of Earnings.

REPUBLIC RAILWAY & LIGHT.

	1914	1913
October gross	$ 253,133	$ 257,302
Net after taxes	97,137	98,022
Surplus after charges	39,285	37,822
Balance after preferred dividends	13,328	11,865
Ten months gross	2,512,306	2,450,705
Net after taxes	1,007,981	916,475
Surplus after charges	435,852	329,852
Balance after preferred dividends	176,282	70,282

AMERICAN GAS & ELECTRIC.

Four subsidiaries for 12 months ended October 31:

Canton Electric Co.—	1914	1913
Gross earnings	$ 520,845	$ 397,702
Net earnings	246,716	200,369
Surplus after charges	182,053	142,943
Rockford Electric Co.—		
Gross earnings	$ 491,280	$ 452,765
Net earnings	267,004	240,883
Surplus after charges	174,047	151,515
Scranton Electric—		
Gross earnings	$1,094,637	$ 886,943
Net earnings	651,828	536,584
Surplus after charges	407.540	338,914
Wheeling Electric—		
Gross earnings	$ 341,458	$ 303,181
Net earnings	160,250	142,660
Surplus after charges	91,176	86,606

PACIFIC POWER & LIGHT.

	1914	1913
November gross	$118,662	$111,170
Net after taxes	62,546	58,305
Surplus after charges	29,395	29,111
12 months' gross	1,363,552	1,286,985
Net after taxes	708,405	624,057
Surplus after charges	325,958	288,659
Balance after preferred dividends	80,958	46,159

KANSAS GAS & ELECTRIC.

	1914	1913
November gross	$103,618	$102,735
Net after taxes	42,785	41,310
Surplus after charges	27,191	26,213
12 months' gross	1,139,943	1,018,755
Net after taxes	419,331	361,311
Surplus after charges	238,323	185,752
Balance after preferred dividends	133,323	80,752

SOUTHWESTERN POWER & LIGHT.

	1914	1913
November gross	$258,381	$232,663
Net after taxes	126,828	101,638
12 months gross	2,771,038	2,240,708
Net after tax	1,280,812	1,011,487

CENTRAL STATES ELECTRIC CORPORATION.
(Cleveland Electric Illuminating.)

	1914	1913
November gross	$377,523	$374,084
Net after taxes	195,986	183,641
Balance after amort., pfd. dividends & int.	161,883	150,264
Surplus after depreciation	124,131	112,864
12 months' gross	4,249,869	3,971,292
Net after taxes	2,008,440	1,926,765
Balance after int., pfd. divs. & amortization	1,583,954	1,511,447
Surplus after depreciation	1,158,969	1,067,083

PERSONAL MENTION.

MR. H. H. NOBLE has resigned as president of the Northern California Power Company, and has been elected chairman of the Board of Directors. MR. W. F. DETERT has been elected president to succeed Mr. Noble.

MR. TIMOTHY C. O'HEARN, city electrician of Cambridge, Mass., for the past 10 years, has resigned, to become effective April 1, 1915. Mr. O'Hearn graduated from the Massachusetts Institute of Technology, Boston, and is now an instructor in the institution.

MR. FREDERICK D. NIMS, electrical engineer and general superintendent of the Western Canada Power

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

	Dec. 28	Dec. 21
American Tel. & Tel. (New York)	116½	117¾
Commonwealth Edison (Chicago)	136	136
Edison Electric Illuminating (Boston)	248	—
Electric Storage Battery common (Philadelphia)	47¼	49
Electric Storage Battery preferred (Philadelphia)	47¼	49
General Electric (New York)	137	139¾
Kings County Electric (New York)	120	120
Massachusetts Electric common (Boston)	8	8
Massachusetts Electric preferred (Boston)	50	—
National Carbon common (Chicago)	119	119
National Carbon preferred (Chicago)	119	119
New England Telephone (Boston)	128¼	—
Philadelphia Electric (Philadelphia)	23⅝	23¾
Postal Telegraph and Cables common (New York)	70	—
Postal Telegraph and Cables preferred (New York)	67	—
Western Union (New York)	57	57¾
Westinghouse common (New York)	66½	68½
Westinghouse preferred (New York)	—	—

Company, Ltd., has severed his connection with that company to take an important engineering position with the Olympic Power Company at Port Angeles, Wash.

MR. W. H. BLOOD, of the Stone & Webster Engineering Corporation, Boston, addressed the Electrical Engineering Society of the Massachusetts Institute of Technology last week on "Some Suggestions for the Making of Examinations and Reports." Mr. Blood is a graduate of the Institute.

MR. WILLIAM MAIN, of Stroudsburg, Pa., has been elected to the position of general manager of the Blue Mountain Telephone & Telegraph Company succeeding C. H. Klauder, whose resignation took effect December 1. Mr. Main recently resigned as superintendent of the Stroudsburg & Bushkill Telephone Company, after giving that concern two years of very successful service.

MR. C. E. GROESBECK has been appointed vice-president and general manager of the Utah Power & Light Company, with headquarters at Salt Lake, as successor to Mr. P. B. Sawyer, who has resigned. Mr. Groesbeck has been connected with the Electric Bond and Share Company for some time past, and prior to that was about eight years in the organization of H. M. Byllesby & Company, principally in their Pacific coast properties. He has spent the last two months in Salt Lake City familiarizing himself with the organization and operation of the company preparatory to assuming the duties of this important position.

MR. ALONZO R. WEED, for the past eight years a member of the Gas and Electric Light Commission of Massachusetts, has been designated Chairman of the Commission by Governor Walsh, succeeding the late Mr. Forrest E. Barker, who died November 21. Mr. Weed was born in Bangor, Me., in 1867 and went to Massachusetts in early childhood. He was educated in the public schools of Newton, where he has since made his home. He graduated from Harvard College in 1887 and from the Boston University Law School in 1890. He was admitted to the bar immediately after and thereupon took up the practice of law in Boston. For 20 years Mr. Weed taught in the Boston University Law School, his subjects being equity and later equity pleading. He was a member of the Board of Aldermen of the City of Newton for five years, two of which he was president of the board. He was mayor of Newton in 1904 and 1905.

MR. PAUL B. SAWYER has resigned his position as vice-president and general manager of the Utah Power and Light Company, of Salt Lake City. Mr. Sawyer has held the position as general manager of this company since its organization a little over two years ago when the Electric Bond and Share Company acquired the control of all the electrical interests in the state of Utah outside of Salt Lake City and Ogden, and parts of southern Idaho and merged them to form the Utah Power and Light Company. The task of welding together 15 or 20 separate and dissimilar properties with their great differences in operating conditions and commercial policies and rates has devolved largely upon Mr. Sawyer and the results secured, considering the business and financial conditions which have obtained during this period are a strong testimonial to his ability. He resigns to accept a position in the organization of Harrison Williams, of New York city, with offices at 60 Broadway. Prior to his connection with the Utah Power and Light Company Mr. Sawyer was general manager of the Des Moines Electric Company.

OBITUARY.

MR. CHARLES MARTIN HALL, inventor of the electrolytic process for the manufacture of aluminum, died on December 27 at Daytona, Fla. Mr. Hall was 51 years old, and had been in ill health for several years. Charles Martin Hall was born in Ohio and educated at Oberlin Academy, graduating in 1885. He was an ardent student of chemistry and concentrated his attention upon a process for securing aluminum in commercial quantities from bauxite. He began the commercial manufacture of aluminum with the Pittsburgh Reduction Company in 1888. Since 1890 he has been vice-president of the company, and its successor, the Aluminum Company of America. His patent on the process was issued in 1886, but the priority right to the invention was not conceded in the courts until 1893. It was in that year that Oberlin Academy conferred upon Mr. Hall the degree of LL. D. Mr. Hall was a member of the American Philosophical Society, the American Institute of Mining Engineers, Franklin Institute, American Electrochemical Society, New York Chamber of Commerce, a trustee of Oberlin Academy, and ex-president of the Niagara Falls Memorial Hospital. When the New York Section of the American Chemical Society met in New York, Mr. Hall received the Perkin medal for work in chemistry.

DATES AHEAD.

Electrical Contractors' Association of the State of Illinois. Semi-annual meeting, Chicago, Ill., January 15-16. Secretary, E. J. Burns, Rock Island, Ill.

Electrical Contractors' Association of Wisconsin. Annual meeting, Milwaukee, January 18-20. Secretary, Albert Petermann, 626 Lloyd Street, Milwaukee, Wis.

Wisconsin Electrical Association. Annual convention and joint meeting with Wisconsin Gas Association, Hotel Pfister, Milwaukee, January 20-22. Secretary, George Allison, First National Bank Building, Milwaukee, Wis.

Independent Telephone Association of America. Annual convention, Hotel Radisson, Minneapolis, Minn., January 19-21. Secretary, W. S. Vivian, 19 South La Salle Street, Chicago, Ill.

American Wood Preservers' Association. Annual convention, Congress Hotel, Chicago, Ill., January 19-21. Secretary, F. J. Angier, Baltimore, Md.

Northern White Cedar Association. Nineteenth annual meeting, Minneapolis, Minn., January 26-27. Secretary, N. E. Boucher, Minneapolis.

Western Association of Electrical Inspectors. Annual meeting, Hotel Radisson, Minneapolis, Minn., January 26-28. Secretary, W. S. Boyd, 175 West Jackson Boulevard. Chicago, Ill.

National Convention of Builders' Exchanges. Columbus, O., January 26-28.

With the Electrical Manufacturers

The American Manufacturers' Agency, Incorporated, 111 Monroe Street, Chicago, Ill., has taken the agency for the Burnley Battery & Manufacturing Company, of North East, Pa., to handle the well known Burnley soldering paste, soldering stick and soldering salts in Illinois, Wisconsin, Minnesota and Iowa. The agency has always become the distributor for the Novelty Incandescent Lamp Company, of Emporium, Pa., manufacturers of all kinds of incandescent lamps.

The Rauch & Lang Carriage Company, 2180 West Twenty-fifth Street, Cleveland, O., has issued an artistic booklet entitled "Through Sixty Years." It refers to the long career of the company in building the highest types of carriages and coaches. The excellent reputation established has been won on the quality of the vehicles turned out and this is being maintained by the company's electric cars. Seven types of these are illustrated and briefly described, their comfort features being particularly emphasized.

The Brown Instrument Company and the **Keystone Electrical Instrument Company,** Philadelphia, Pa., have removed their works to the new plant located at Wayne Junction, Wayne and Windrim Avenues, Philadelphia, Pa. In a circular announcing this change four views of the new, large and well equipped factory are shown.

C. G. Reed and C. Leonard have formed a partnership to deal in electrical material and are representing manufacturers in Baltimore, Md., Washington, D. C., and vicinity. The office of this firm is at 705 American Building, Baltimore, Md. Both Mr. Reed and Mr. Leonard were formerly connected with the Westinghouse Elec-

tric & Manufacturing Company. Reed and Leonard have announced that they have taken the agency for the Electric Cable Company's products in this territory.

Indiana Rubber & Insulated Wire Company, Jonesboro, Ind., has issued a new catalog descriptive of Paranite wires and cables. This illustrates and describes comprehensively the products of this company, and in addition gives a great deal of very interesting wiring information. Copies may be received upon application to the company or to its Chicago office, 210 South Desplaines Street.

Columbia Lamp Division, National Lamp Works of General Electric Company, St. Louis, Mo., has issued a pamphlet on the Photolite. This interesting unit consists of a 1,000-watt Mazda lamp with blue bulb and angle steel reflector mounted on an adjustable stand with diffusing screen. The outfit has been designed particularly for portraiture work in photographic studios. It permits taking pictures at all times with as good speed and general satisfaction as under the best daylight.

Asbestos Protected Metal Company, Beaver Falls, Pa., has issued bulletin No. 54 on Asbestosteel for roofs and walls. This roofing material consists of a rectangularly corrugated sheet-steel body protected by asphalt, asbestos and a special waterproofing, a steel reinforcement and a concrete filling for the corrugations. A similar type of construction for walls consists of Asbestosteel lath covered with concrete. The bulletin is copiously illustrated with excellent detail views of the construction and many fine views of completed buildings in which it is employed. Much interesting information and data are included with the description.

Busch-Sulzer Brothers-Diesel Engine Company, St. Louis, Mo., has issued a bulletin of tests of the Diesel engine to determinate its economy and efficiency under steady and fluctuating loads. These tests were made on a standard 225-horsepower Diesel engine that had been in operation for six months without any adjustment. The bulletin sets forth the details of the tests and gives their results both in tabular and graphic form. The results showed a fuel consumption of not quite six gallons of oil for 100 net brake-horsepower-hours. This oil cost $1.22 per barrel of 42 gallons, consequently the fuel cost was a little less than 1.75 mills per brake-horsepower-hour, an exceptionally low figure.

The Leeds & Northrup Company, 4901 Stenton Avenue, Philadelphia, Pa., has issued bulletin No. 806, which describes the resistance type of calorimetric thermometer employing the resistance bulb developed by Dr. Dickinson, of the Bureau of Standards. The three other elements of the equipment are the resistance bridge, galvanometer, and galvanometer reading device. An exceptional degree of accuracy is attainable by use of the apparatus. The company has also issued bulletin No. 813A, on resistance thermometers for electrical machinery. The temperature of the test coil is measured either by means of a direct-reading temperature-indicator, similar to standard switchboard dial-type instruments, or by a balance indicator employing a Wheatstone bridge.

The D. & M. Lamp & Lighting Company, Incorporated, 13 Astor Place, New York, N. Y., will engage in the business of selling carbon, tungsten and nitrogen-filled lamps, electric fixtures and will undertake contracting work of every description under the head of general lighting. The officers of the company are George L. Deverall, president; Archibald J. McKinny, vice-president; Alexander McKinny, Jr., secretary and treasurer. The company has taken an active part in appearing before municipal authorities, demonstrating the efficiency and economy of the nitrogen-filled lamp for general and street illumination. At the company's office at 13 Astor Place, New York, a test board has been installed and demonstrations of the several types of lamps are being made.

General Vehicle Company, Incorporated, Long Island City, N. Y., has issued a well illustrated book entitled "Efficient Motor Transportation with G. V. Electrics." This shows five views in the manufacturing plant of the company, nearly 10 views of various parts of its electric commercial cars, 20 views of typical electric delivery wagons and trucks and 12 views of fleets of these cars. The pamphlet sets forth the broad policy followed by the company in the manufacture of its vehicles. Electric trucking by means of these cars comprehends adaptability, speed mileage, minimum maintenance cost and maximum earning power. The manner in which these are insured is clearly set forth. The company's electric cars range from the 1,000-pound delivery wagon to the five-ton truck.

General Electric Company, Schenectady, N. Y., has just issued a number of new publications, of which bulletin No. 42,010 describes small horizontal turbogenerator sets ranging from 7 to 300 kilowatts; they are used largely for supplying light and power in mills, machine shops, laundries, bakeries, breweries, apartment houses, etc., as well as for train lighting; the turbines can be furnished for either condensing or non-condensing operation and for any steam pressure of over 80 pounds. In bulletin No. 42,300 is described the company's line of small direct-connected generating sets ranging from 2.5 to 75 kilowatts; while ordinarily designed to meet the severe conditions of marine work, they are also well adapted and used extensively for both power and lighting in isolated plants, and as exciters for alternating-current generators in central-station work. Bulletin No. 45,602 deals with the protection of series lighting circuits by lightning arresters of the horn type and the aluminum-cell type; the former are designed for the protection of series transformers and rectifiers against lightning discharge and similar trouble, and the latter particularly for the protection of cable circuits running from series arc rectifiers.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has recently issued the following new publications: "Lighting Protection for Cars," describes types MP and K lightning arresters, which are of the equivalent-spark-gap type. "Direct-Current Motors for Driving Job Printing Presses," describes the characteristics of motors necessary for this kind of work; several types of motors are shown and described. "Westinghouse Low-Pressure Turbines," gives the classification of low-pressure turbine installations according to the service in which they are used; brief descriptions are given of the different classes of service. "Large Slip-Ring Induction Motors" describes motors designed for driving hoists, cranes, and similar applications where operation is not continuous, but consists of intermittent loads calling for high torque. "Motor-Driven Bakers' and Confectioners' Machinery" is the title of a well arranged pamphlet with an art cover, dealing with the use of motors for this class of service and the particular advantages derived by the use of electric drive; tables are shown giving the horsepower rating for the different classes of machines; a typical installation is described, showing the kilowatt-hour consumption of each machine. Westinghouse direct-current motors for group drive of sewing machines are illustrated and described in leaflet No. 3519-A, which deals with electric drive for sewing machines in factories. "Small Motors No. 21," deals with the characteristics of this type of motor for alternating and direct-current work; a number of views showing detail parts and the completed motor are shown, one particularly interesting one illustrating the excellent ventilation of this type of motor. Folder No. 4292 covers watt-hour meters and explains their adaptability to central-station service; detail views are shown and full description of this type of meter is given. "For Better Projection" is the title of a folder covering the use of Cooper Hewitt rectifiers for motion-picture service; the latest developments in this rectifier are shown and reasons for its adoption for motion-pictures made clear. Leaflet No. 3523, covering Westinghouse No. 328 railway motors, describes in detail this type of motor, which is particularly adapted to city and light interurban service where an effort is made to use a car of exceptionally light weight and small wheels. Leaflet No. 3784 describes the new type of control, known as PK, recently brought out by the company; this arrangement is especially adapted for standard K controllers, and has been adopted by a large number of traction systems.

Record of Electrical Patents.

Issued by the United States Patent Office, December 22, 1914.

1,121,601. Electrical Conductor. T. B. Allen and L. B. Coulter, assignors to Carborundum Co., Niagara Falls, N. Y. A porous body impregnated with graphite.

1,121,607. Hanger for Trolley Wires. G. H. Bolus, assignor to Ohio Brass Co., Mansfield, O. Catenary hanger of inverted-J-shaped section with trolley ear at the bottom.

1,121,619. Method of Making Valves. R. L. Ellery, Toledo, O. Includes application of electric current to melt the contacting portions.

1,121,625. Swivel Arrangement for Electric Terminal Plugs. M. Herskovitz, Chi-

cago, Ill. Permits the screw sleeve of attachment plug to turn.

1,121,626. Means for Measuring the Frequency of an Alternating Current. C. E. Hiatt, assignor to Westinghouse Electric & Mfg. Co. Frequency meter of Wheatstone-bridge type.

1,121,635. Controller for Heating Systems. F. T. Kitchen, assignor to Gold Car Heating & Lighting Co., New York, N. Y. Thermostatic electromagnetic circuit-controller.

1,121,649. Elevator Signal. C. A. McIntyre, Philadelphia, Pa. Electric signaling system with floor and advance signals located in the car.

1,121,664. Plug. O. Prochazka, Detroit, Mich. Has push rod extending obliquely through attachment plug to wedge it in socket.

1,121,666. Automatic Telephone Exchange. F. N. Reeves and A. E. Lundell, assignors to Western Electric Co. Automatic switching and idle trunk selection between satellite offices and main office.

1,121,674. Rheostat-Resistance Car-Heater. J. T. Skinner, Lawrence, Kans. Method of mounting in framework.

1,121,725. Electromagnetic Brake-Operating Mechanism. G. E. Hindley, Park Ridge, N. J. Has several magnet coils side by side.

1,121,739. Telephone-Toll-Line System. F. A. Lindquist, assignor to Western Electric Co. Relates to control of coin box.

1,121,743. Apparatus for Heating,

1,121,928.—Portable Lamp.

Evaporating, Volatilizing, or Distilling Liquids by Electricity. T. McClelland, Jr., Cathcart, Scotland. Has perforated tube containing compressed carbon resistance.

1,121,750. Electrical-Circuit-Changing Switch. T. B. Miller, assignor of one-half to Smith Cannery Machines Co., Seattle, Wash. Interlocked rotary switch.

1,121,754. Automobile Lamp Signal. F. Pastor, Akron, O. Rear direction signals electrically controlled by steering rod.

1,121,759. Incandescent-Bulb Remover and Replacer. F. H. Printiss, assignor of 51 per cent to G. C. A. Mfg. Co., Pittsfield, Mass. Has flexible stem and adjustable lamp grips.

1,121,764. Method of and Apparatus for Rectifying Electric Currents. C. F. Ruprecht, Cleveland, O. Electrolytic cell with rod and concentric tubular electrodes.

1,121,769. Frame for Rheostat Resistance Elements. J. T. Skinner, Lawrence, Kans. Metal frame for grip resistor.

1,121,771. Battery. E. Sokal, Chicago, Ill. Provides circulation of chlorine gas as depolarizer.

1,121,786. Motor Controller. T. E. Barnum, assignor to Cutler-Hammer Mfg. Co., Milwaukee, Wis. Has electromagnetic switches with provision for dynamic braking.

1,121,792. Method of Compressing Baked Carbon Articles and Closing Laminations and Seams Therein. J. W. Brown, assignor to National Carbon Co., Cleveland, O. Consists in passing current through article while compressing it.

1,121,798. Drum-Armature-Winding Machine. P. E. Chapman, St. Louis, Mo. Chuck with transversely adjustable jaws and wire-directing guides.

1,121,802. Method of Coating Projector Lamps with Reflecting Surfaces. E. L. Clark, assignor to National Carbon Co. Consists in freeing the interior of oxidizing gas, heating part of the bulb, cooling the remaining part and heating a supply of coating materials so that its vapor will condense on the interior surface of the cool portion.

1,121,823. Time-Announcing System. M. F. Geer, assignor to General Railway Signal Co., Gates, N. Y. Combined electric time-indicating and selective signaling system.

1,121,827. Electric-Lamp-Supporting Device. B. J. Grigsby, assignor to Benjamin Electric Mfg. Co., Chicago, Ill. Lamp socket with threaded shell for shade-holder engagement.

1,121,834. Electrical Measuring Apparatus. C. E. Hiatt, assignor to Westinghouse Electric & Mfg. Co. Frequency meter with several thermo junctions.

1,121,835. Comparator. C. E. Hiatt, assignor to Westinghouse Electric & Mfg. Co. Has opposed thermo coupler and an adjustable heater for each.

1,121,855. Electrically Controlled Animal Power. R. D. McCreery, Rochester, N. Y. Horse-driven generator with electrically controlled whip.

1,121,860. Process and Apparatus for Hydrogenating Unsaturated Compounds. H. K. Moore, Berlin, N. H. Electrically controlled process for hydrogenating oil through catalysis.

1,121,874. Zinc Furnace. O. E. Ruhoff, Madison, Wis. Electric resistance-type furnace.

1,121,876. Rechargeable Electric Fuse. A. Schipper, Ogden, Utah. Ends of the fuse wire are bent between inner and outer end caps.

1,121,877. Electric Switch. W. M. Scott, J. H. Wyatt and T. W. Greathead, assignors to W. M. Scott, Radnor, Pa. Yielding laminated contact for heavy currents.

1,121,892. Battery-Charging System. C. E. Beach, assignor to G. O. Knapp, New York, N. Y. Time-controlled automatic cut-out.

1,121,897. Relay. E. B. Craft, assignor to Western Electric Co. For telephone switchboard.

1,121,928. Portable Electric-Light Support, D. C. Lamb, assignor to Lamb Bros. & Greene, Nappanee, Ind. Has cord reel mounted in base of stand. (See cut.)

1,121,935. Railway-Rail Joint. J. C. Mock, Detroit, Mich. Insulated joint.

1,121,939. Rail Insulator. J. G. Mueller, Dayton, O. Insulated track rod passes transversely through base-clamping joints.

1,121,953. Telephone Metering System. E. Thomson, assignor to General Electric Co. Generator is periodically energized to oppose the battery.

1,121,960. Molded Metallic Article and Method of Making the Same. W. R. Whitney, assignor to General Electric Co. Collecting brush contains molybdenum sulphide.

1,121,966. Electric Heating Unit. H. P. Ball, assignor to General Electric Co. Metal-sheathed resistance wire brazed to metal plate.

1,121,979. Thermoelectric Regulator. E. F. Collins, assignor to General Electric Co. For electric furnace.

1,121,983. Automatic Regulator for Electric Circuits. A. S. Cubitt, assignor to General Electric Co. Electromagnetically vibrated shunt resistance.

1,121,986. Subaqueous Audible Signaling Apparatus. S. M. Davison, assignor to Marconi's Wireless Telegraph Co., Ltd., London, Eng. Electric transmitter mounted in hull of ship.

1,121,988. Automatic Control and Sanding Device for Cars Operating on Slippery Rails. J. S. Doyle, Mount Vernon, and F. Hedley, Yonkers, N. Y. Electric control of sander dependent on slipping of wheels.

1,121,996. Electrical Circuit-Breaker. E. Gassmann, assignor to Eisemann Magneto Co., Brooklyn, N. Y. Movable contact is mounted on flexible spring arm.

1,121,997. Electrical Cutout. E. G. Gilson, assignor to General Electric Co. Film series-lamp cutout consisting of an absorbent paper impregnated with graphite, tungsten and shellac between two lead-tin alloy plates.

1,122,001. Ignition System for Internal-Combustion Engines. J. O. Heinze, Detroit, Mich. Special electromagnetic control of the vibrator.

1,122,010. Lock Circuit-Closer. J. F. Lesko, Chicago, Ill., assignor of one-half to A. J. Franek. Electric alarm.

1,122,011. Process and Apparatus for Producing Roentgen Rays. J. E. Lilienfeld, Leipzig, Germany. Includes means for impressing synchronous alternating heating current.

1,122,016. Portable Protecting Apparatus. E. L. Maltby, assignor to New York Safety Chest Co., New York, N. Y. Electric alarm for safety chest.

1,122,019. Electic Switch. E. B. Merriam, assignor to General Electric Co. Vented chamber for oil switch.

1,122,021. Safety Chest. L. Myers, assignor to New York Safety Chest Co. Electric alarm circuit is closed if chest is tilted.

1,122,027. Method of Tuning Alternating-Current Circuits. M. Osnos, assignor to General Electric Co. Consists in varying field exisitation of alternator until its total inductance is the desired amount.

1,122,028. Test-Connector. F. R. Parker, Chicago, Ill. Interconnected wire clamps.

1,122,030. Suspension-Insulator Eyebolt. J. A. Sandford, Jr., assignor to R. Thomas & Sons Co., East Liverpool, O. The shank has longitudinal and transverse ribs. (See cut.)

1,122,031. Pull Socket. H. R. Sargent and T. Koch, assignors to General Electric Co. Details of mechanism.

1,122,032. Thermal Circuit-Closer. J. F. Scheuer, Two Rivers, Wis. Includes fusible sleeve.

1,122,034. Mining Machine. F. L. Sessons, assignor to Jeffrey Mfg. Co., Columbus, O. Motor-driven coal cutter.

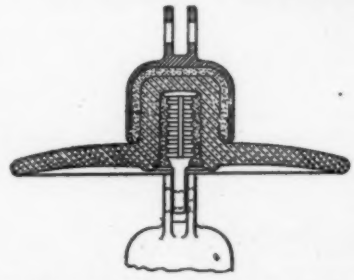
1,122,041. Electric Broiler. W. Stanley and H. P. Ball, assignors to General Electric Co. Has heating unit in the peripheral part.

1,122,045. Electric Switch. F. L. Temple, assignor to Bryant Electric Co., Bridgeport, Conn. Double-pole rotary snap switch.

1,122,086. Combined Mouth Prop and Illuminator. W. F. Dunlop, New York, N. Y. Electric lamp in dental outfit.

1,122,104. Submarine Camera. H. Gruen, New York, N. Y. Includes an electric motor and electric lamps.

1,122,126. Means for Fastening the



1,122,030.—Suspension Insulator Eyebolt.

Dangling End of a Broken Overhead Electric Conductor. A. Jürgens, assignor to G. Lekkerkerker, Utrecht, Netherlands, and P. J. Beckx, Tegelen, Netherlands. Pulley, clamp and rope arrangement.

1,122,146. Electric Engine-Starter. M. P. Mitchell, Eaton, O. Motor-generator outfit.

1,122,164. Illuminating Sign. A. E. Schneider, New York, N. Y. Lamps are mounted on the front walls of the letters between their rearwardly extending sides.

1,122,167. Spinning or Twisting Apparatus. L. W. Southgate, Worcester, Mass. Induction motor is mounted on ring rail and has the spinning ring connected to its rotor.

1,122,181. Vehicle Speed Indicator and Controller. J. L. Wheeler, Napa, Cal. Includes an electric buzzer actuated when speed limit is exceeded.

1,122,185. Vapor Electric Apparatus. C. O. Bastian, assignor to Cooper Hewitt Electric Co., Hoboken, N. J. Quartz-tube lamp with subsidiary contact beyond the main mercury electrodes.

1,122,187. Coil Support. B. A. Behrend, assignor to Allis-Chalmers Mfg. Co. Slotted rings for holding the ends of the stator coils.

1,122,193. Electric Coupling. J. L. Cobb, Los Angeles, Cal. Combination air-brake and circuit coupling between cars.

1,122,194. Electrode Holder for Arc Lamps. C. W. Brake, assignor to Pyle National Electric Headlight Co., Chicago, Ill. For headlight carbon with fluted sides.

1,122,197. Convertible Signal Lamp. F. W. Dressel, New York, N. Y., assignor to Dressel Railway Lamp Works. Interchangeable oil and electric lamp.

1,122,213. Adjustable End Head for Dynamo-Electric Machines. E. Mattman, assignor to Allis-Chalmers Mfg. Co. Has eccentric bushings for adjustment.

1,122,226. Semi-Indirect-Lighting Fixture. H. C. Adam, St. Louis, Mo. Conical ceiling reflector and cup-shaped diffusing bowl.

Electric Vehicle Section

ELECTRICAL EQUIPMENT OF GARAGES.

By Norman G. Meade.

Chicago may be truthfully called the mecca of the electric vehicle, especially for the pleasure car. With its level and well paved streets, and a park and boulevard system covering upwards of 70 miles, the development of the electric for pleasure purposes has been rapid and has brought the city into prominence as a leader in the use of this class of vehicles. This has naturally led to the building and equipping of numerous garages devoted to the care of electric cars exclusively.

In the issue of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, November 7, the Lake Shore Auto Station, one of the largest in the city, was described; this article takes up the description of two somewhat smaller electric garages in the same section of the city, one of which, the North Shore Garage, is of especial interest owing to the extensive repair shop facilities where heavy and light repairing of all kinds is executed, and cars are completely rebuilt and new cars assembled. Some of the repair work cannot be classed as strictly electrical, but has a direct bearing on the subject as it is in connection with electric vehicles.

Fig. 1.—Interior of North Shore Garage.

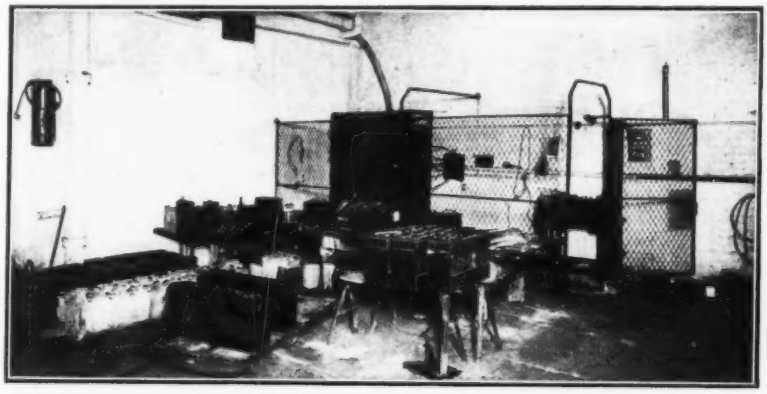


Fig. 2.—Corner of Battery Department and Repair Shop.

North Shore Garage.

The North Shore Garage, located at 1452-54 North Clark Street, is owned and operated by Messrs. Cornwell & Inman, two gentlemen who have had wide experience in the manufacture of electric vehicles. It has a capacity of 40 cars which are maintained on a monthly basis of $30, $35 and $40, depending upon the capacity. Pleasure cars only are housed and most of these are coupes.

Charging and washing are done in the main or front part of the building, which is one story in height and receives an abundance of natural light from two large skylights, aside from the extensive windows in the front. The rear of the building is three stories in height; the first floor is occupied by the battery repair department and the general repair shop. The second

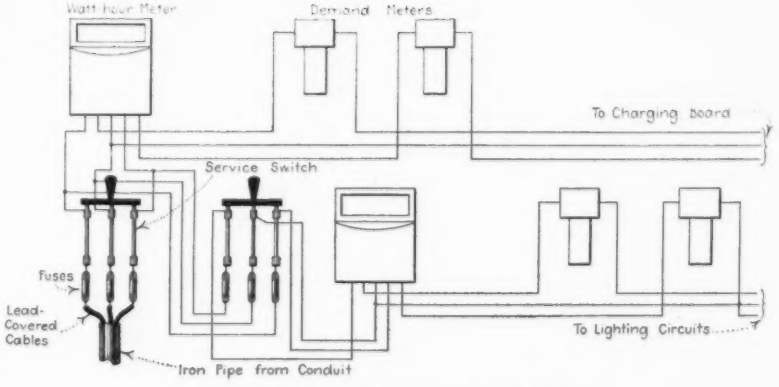


Fig. 3.—Diagram of Service Connections.

floor is the paint shop and the third floor the trim department where tops, curtains and upholstered seats are repaired and made. It is planned to install in the near future an elevator in this part of the building to transport cars to all floors. At the present time assembled cars are painted on the first floor. Facilities are also at hand for certain gasoline car repairs such as rewiring, rebuilding and charging ignition batteries and the renewing of trimmings.

At the rear of the main building there is a pit over which cars can be run to facilitate access to the under side, and the removal of the parts beneath the car. The arrangement is similar to that found in street railroad repair shops. The entire repair equipment is designed to facilitate rapid execution of orders.

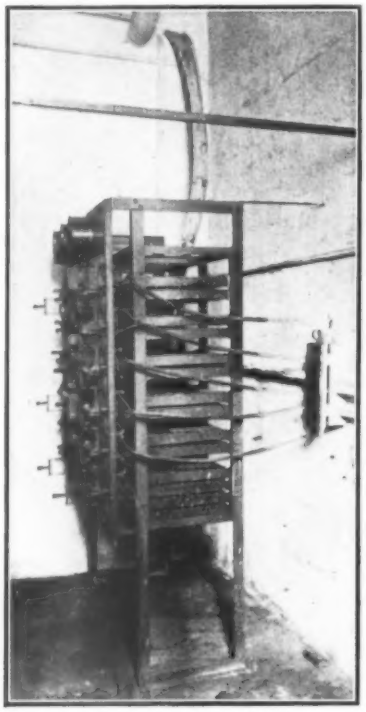


Fig. 4.—Charging Switchboard in Inclosing Cage.

Batteries of all makes are assembled to suit the purchaser and no particular type is recommended. Repair and charging service is continuous through the 24 hours, which from 6 p. m. until 5 a. m. is under the charge of a battery man and a mechanic. The operations during the day time are under the direct supervision of the proprietors.

A general interior view of the garage is shown in Fig. 1 and a corner of the battery repair department and repair shop is illustrated in Fig. 2.

Current is supplied by the Commonwealth Edison Company, feeders from the three-wire 110-220-volt direct-current distribution system entering at the rear through iron pipe connecting with subway ducts. The main feeder cables, which are lead covered, enter a pressed steel cabinet containing the service switch and fuses; a set of branch feeders connects with the lighting system switch, also enclosed in a sheet metal cabinet. The entrance connections are shown diagrammatically in Fig. 3; both the power circuit and the lighting circuit are metered by three-wire integrating wattmeters and each circuit is also provided with two Wright maximum demand meters connected in the outside wires of the three-wire system.

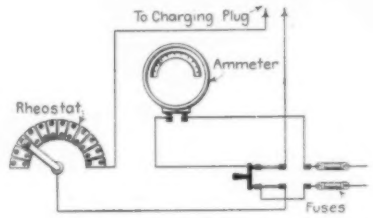


Fig. 5.—Ammeter, Switch and Rheostat Connections.

Feeders from the entrance to the charging board are carried on cleats and pass through the wall to the front department where they are encased in circular loom to the rear of the board. The charging switchboard, which is surrounded by a wire cage, is shown in Fig. 4 and was manufactured by Schaffer Brothers, Chicago. It is equipped with a voltmeter and twelve point voltmeter switch; two ammeters, one for each side of the system; twelve charging rheostats; twelve double-pole, double-throw circuit switches with fuses and triple-pole main switch with fuses. The switches and fuses are mounted in two vertical rows of six each, connected to opposite sides of the system to preserve balance. The double-pole, double-throw switch, rheostat and ammeter connections are shown in Fig. 5. When the switch is in the position shown, the ammeter is connected in circuit with the car being charged, when the switch is thrown over to the opposite position the ammeter is cut out of circuit. By this arrangement of connections, two ammeters are made to serve any number of charging circuits. Within the switchboard enclosure there is an outlet and bench used for the charging of ignition batteries.

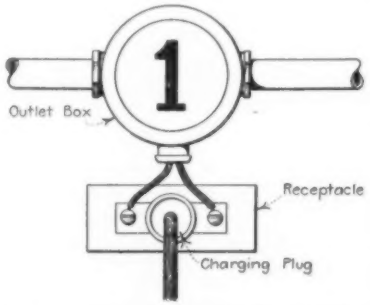


Fig. 6.—Details of Charging Outlets.

From the switchboard twin conductor cables for the charging circuits enter a distribution box with a hinged cover, which is located next to the board and connected with the conduit connecting with the charging outlets. The conduit extends along the north side of the building and is provided with seven outlet boxes located about four feet above the floor. From each of these outlet boxes one twin cable connects with the charging receptacle, as shown in Fig. 6. A parallel conduit runs about two feet above the conduit carrying the charging circuits and is provided with outlets and sockets at short intervals to furnish illumination at the rear of the cars. Extension lamps may also be used in connection with the sockets, for use in and about the cars. A similar arrangement for local lighting is also provided along the south wall of the main building, opposite from the charging side. Each charging outlet is given a serial number corresponding to a number on the switchboard, opposite the rheostat connected with that particular circuit.

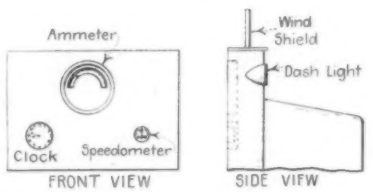


Fig. 7.—Arrangement of Accessories in Runabout.

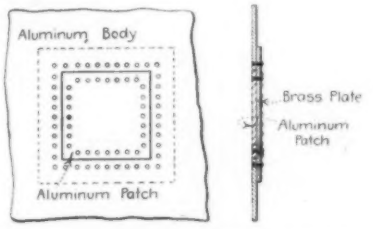


Fig. 8.—How a Damaged Car was Patched.

Quite a number of changes and improvements are contemplated by the proprietors. In the near future they expect to install 18 individual charging panels on the side of the charging room now occupied by the charging outlets. Each panel will take care of two cars or 36 at one time, the capacity of one side of the room. The panels will be constructed so that the maximum charge that any battery can receive will be 35 amperes, making it impossible to overcharge a car equipment. The present switchboard and

Gould Storage Battery

An Electric Car That Climbs Mountains!

Gould Battery Used for Driving

A BEARDSLEY Electric Car, driven by Gould Battery, recently carried its owner and 650 pounds of passenger load up Lookout Mountain, near Los Angeles, Cal.

The route included sharp turns and steep grades which would have made trouble for many gas cars, yet power from the Gould Battery never wavered. The car ran smoothly and evenly as over the level boulevard.

The Gould Battery in the roadster type of Beardsley cars has shown itself capable of a speed of 30 miles per hour and a distance of 100 car miles on each charge.

Do you wonder then that the Beardsley Electric Co. has adopted the Gould Battery as the standard for **all** of its cars?

Tell us the name and model of your car if you want to know what improvement would be made by putting in Gould renewals (which fit jars of any make).

Gould Storage Battery Co.

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DETROIT: Kerr Bldg.
CHICAGO: 225 E. 22nd St.
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GMC

GENERAL MOTORS COMPANY

TRUCKS

The GMC automatic flusher and sprinkler will sprinkle and flush as many miles of street in one day and night, with two drivers, as five teams and five drivers with horse-drawn machines—and do it better for half the money. No noise, no grease, no dirt.

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It's a way that pays Central Station customers, too, for there's a GMC truck for every hauling and delivery need.

If you will give us the facts concerning your problem we can help you solve it.

GENERAL MOTORS TRUCK CO

One of the Units of General Motors Company

PONTIAC, MICHIGAN

Branches: Boston, New York, Philadelphia, Detroit, Chicago, St. Louis, Kansas City.

charging outlets will be utilized for heavier service such as the charging of Edison batteries. For the average operation of pleasure cars, charging the batteries is generally done every other day, so that with the new equipment the capacity of the garage will be materially increased.

As an illustration of the construction work done in the garage, the parts of the chassis and the power plants for ten pleasure cars formerly made by the C. P. Kimball Company of Chicago were purchased and are being assembled. The bodies, tops and trimmings are being made in the repair department and several novel features are introduced. In one car with a runabout body, the steering wheel and shaft are so arranged that they have a lateral movement and can be placed for either left-hand of center control. In this same car there is a false dash, inside the regular dash, with a space between the two, as shown in Fig. 7. The ammeter, clock, speedometer and headlights are placed flush with the outside surfaces which serves to prevent mechanical injury and adds to the neat and attractive appearance of the car.

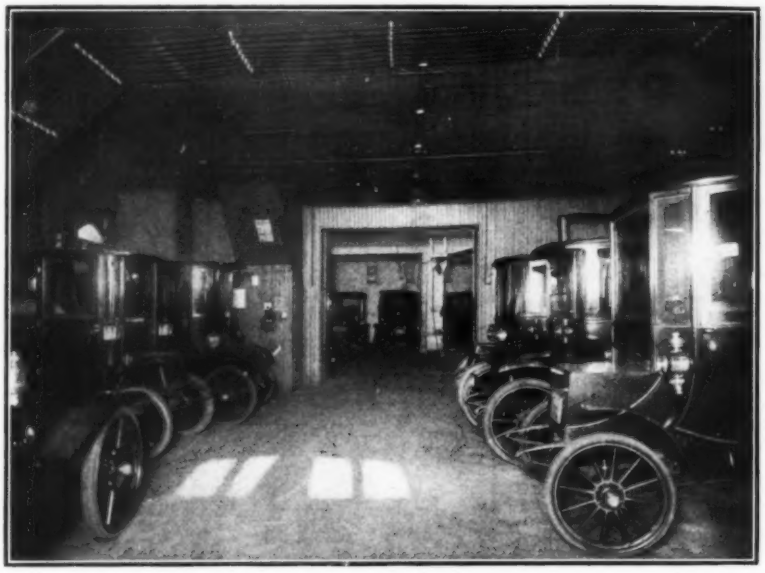


Fig. 9.—Interior of Lincoln Auto Station.

Difficult repair jobs are frequently undertaken and one of a peculiar nature is shown in Fig 8. The body of a coupe was punctured by the tongue of a wagon when a runaway team collided with the car, and the side was also badly bent. The aluminum which composes the body was carefully straightened and the puncture cut out to regular shape. A brass patch was riveted to the inside of the body with the rivets flush with the outside, which was accomplished by countersinking the holes. An aluminum patch was then placed in the space cut out and riveted to the brass patch. After the first coat of body varnish the repaired place could not be detected.

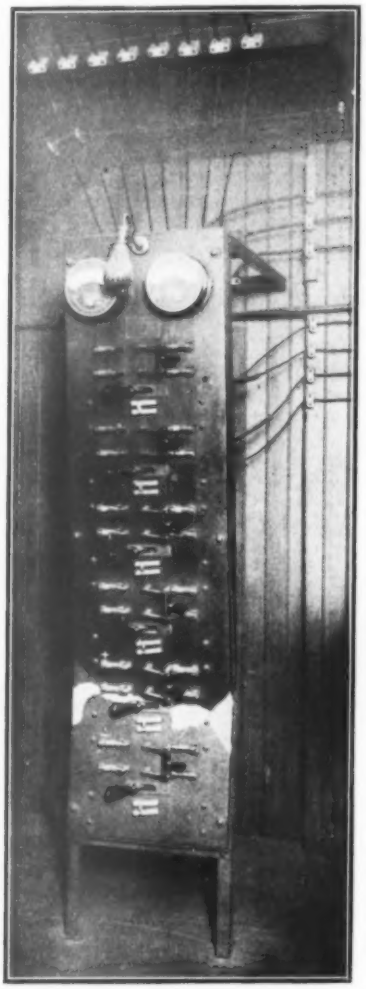


Fig. 10.—Charging Board in Front Room.

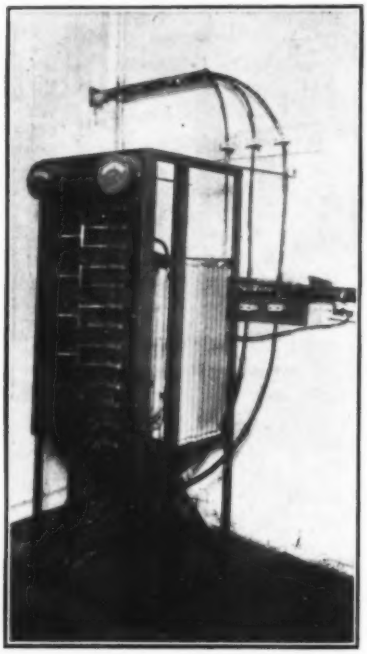


Fig. 11.—Charging Board in Rear Room.

Lincoln Auto Station.

The Lincoln Auto Station, of which Frederick Levey is proprietor, is located at 58 Maple Street, on the North Side of Chicago, and has a capacity of 30 cars, all of which are pleasure machines. Cars are maintained on the monthly basis and facilities are at hand to make all necessary battery and general repairs. The interior, which is shown in Fig. 9, is divided into two rooms with a large doorway connecting them. There are two charging switchboards, one to each room, and twelve charging outlets, half located in the front room and the other half in the rear room. The interior finish of

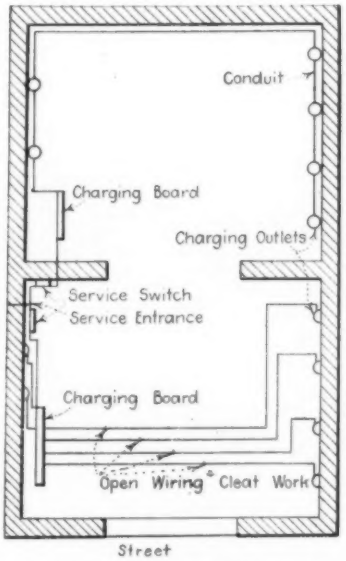
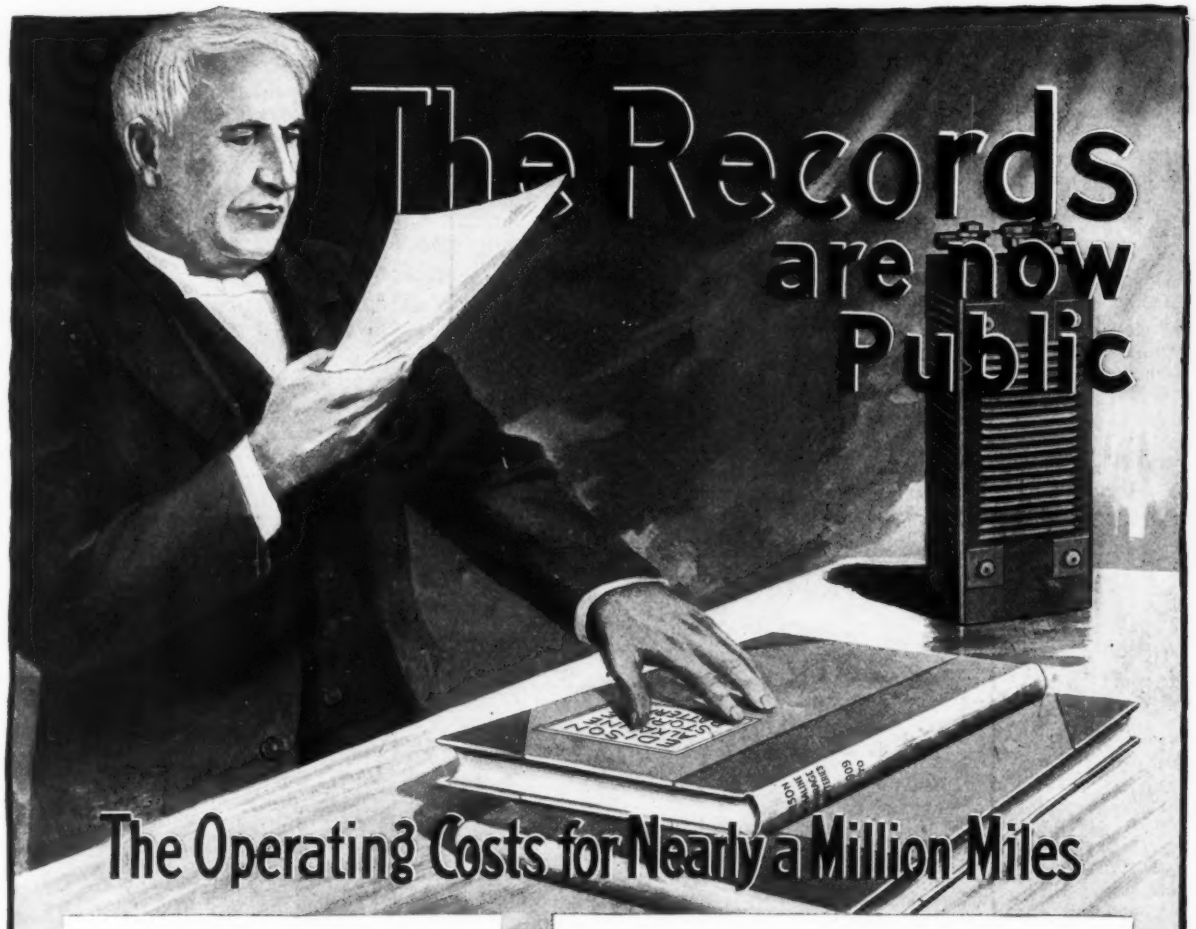


Fig. 12.—Diagram of Garage Wiring.



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Thomas A. Edison

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The Edison Storage Battery Plant at Orange, N. J., was destroyed by the fire in the Edison Phonograph Works on December 9th

Write for Bulletins on the use of **Edison Batteries** for Lighting Country Houses, Ignition and Lighting of Gasoline Cars, Yacht Lighting, Railway Train Lighting and Signaling, Telephone, Telegraph and Wireless *and High-priced or Low-priced Passenger Electrics.*

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GEORGE STEVENS
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NEW YORK, December 7th 1914

Edison Storage Battery Company,
Orange, N. J.

Attention of
Mr. A. Bachman,
V.P.& Genl Mngr.

Gentlemen:-

Thank you for consenting to extend from five to six years the conditions of your guarantee regarding renewal of positive plates.

The average operating cost per battery per month of the twenty-two trucks at Indianapolis, equipped with Edison Batteries in November 1909 and averaging about 660 miles per month, is as follows:-

YEAR	BATTERY MAINTENANCE (Refilling, new solution, watering, cleaning, all repairs, inspection, etc.)		CURRENT (Purchased by meter)	TOTAL
	Material	Labor		
1910	$3.47	$4.10	$10.05	$17.62
1911	3.41	4.10	8.93	16.44
1912	3.41	4.10	9.90	17.41
1913	2.86	4.10	8.17	15.13
1914(to Oct.31)	3.11	4.10	9.50	16.17

The average total operating cost per battery per month has, therefore, been $16.85 for a period of five years. In this time the average mileage per truck was about 40,000, which reduces the operating cost to 1.02¢ per mile. The batteries are still in service.

Yours very truly,

GS-RHW

Superintendent

the garage is Georgia pine and it presents a neat and substantial appearance. Open wiring with porcelain cleats is used in the front room and conduit in the rear.

In the room with the open wiring, the switchboard was built by the J. Lang Electric Company of Chicago and has a capacity of six circuits. At the top of the panel there are two Weston ammeters and a Weston voltmeter. In a vertical row below the instruments are six charging rheostats, six double-pole, double-throw switches with fuses and six voltmeter switches. The double-throw arrangement of the switches is for connecting the ammeters and is similar to that shown in Fig. 5. The six units are connected three to each side of the three-wire system of the Commonwealth Edison Company who furnish direct current at 110-220 volts. The service enters the front room at one side as shown in Fig. 12, which also shows the general arrangement of the wiring and switchboards. The entrance switch and fuses are mounted in a steel cabinet near which is a three-wire integrating wattmeter and two Wright demand meters. There is a branch set of leads to an enclosed main switch which delivers current to the switchboard in the back room. The latter board was made by Schaffer Brothers of Chicago and has a capacity of six circuits. Its connection arrangement is in every way similar to that company's board in the Lake Shore Auto Station described in the issue of November 7. Figs. 10 and 11 show the two boards.

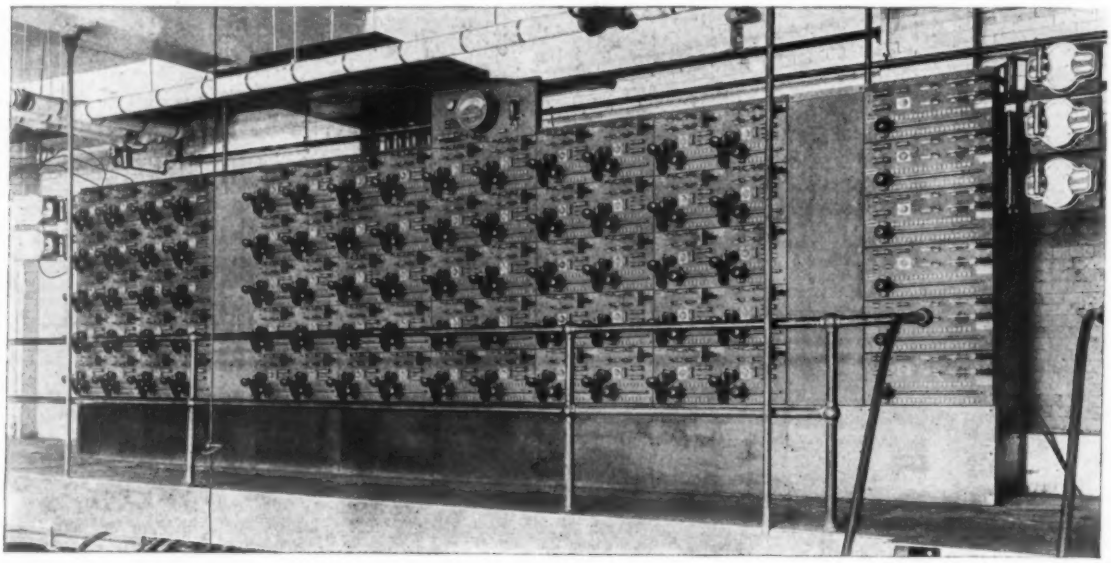
In the front room the wiring for the charging outlets on the side opposite to the switchboard is carried over the ceiling on porcelain cleats and in the rear room the wiring is run in conduit which surrounds three sides of the room about four feet above the floor. The arrangement of the six charging outlets is similar to that shown in Fig. 6.

Electric Charging Equipment in the New Plant of the Ward Bread Company, Boston.

The new Boston plant of the Ward Bread Company has recently been completed and is located in Cambridge. As in New York and Brooklyn electric vehicles will be used by the Ward company in Boston, and the same make of battery-charging equipment has been installed that has been in use in the above cities for several years. The charging equipment installation in the new plant shown in the accompanying illustration is located in a gallery in the engine room adjacent to the garage proper. It consists of the unit-section type rheostats built up into panels to meet the present requirement of charging 70 vehicles. Each unit takes care of two vehicles, there being seven panels of five each of these sections or a total of 35 duplex sections for charging 70 vehicles. At the extreme right there are six special sections for charging, discharging and forming batteries. A power plant on the premises furnishes 115-230-volt, direct-current, three-wire service.

Each of the sections of the charging equipment is a complete unit, carrying cast grid resistance mounted directly on the back. The front carries a double-throw knife-switch, a 15-step horizontal slider-type rheostat, a reverse-current circuit-breaker, enclosed fuses, and two two-candle-power indicating lamps, one for each of the two sets of batteries charged. Each unit carries two rheostats each of which is designed for charging a 42-lead cell battery at 30 to eight amperes. The double-throw knife-switch mounted above each rheostat enables the operator to connect the batteries being charged to either side of the three-wire system, making it possible to keep a close balance on both sides. Special clips on these switches permit taking a reading of the charging current and voltage across the battery simultaneously and without interrupting the charging circuit.

In case the power is "off" or the current is reversed through the battery, the reverse-current circuit-breaker serves to disconnect each battery from the busbars and is so interlocked with the rheostat slider that the attendant cannot begin to charge the battery without first placing all the resistance of the rheostat in series with the battery. Each charging outlet is protected by enclosed cartridge fuses.



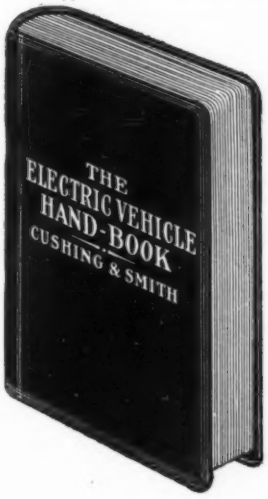
Battery-Charging Equipment Mounted in Gallery of Ward Bread Company, Boston, Mass., for Charging 70 Electric Delivery Vehicles. There are 35 Duplex Sectional-Unit-Type Rheostats in the Main Board and Six Discharging and Forming Rheostats in the Panel at the Right.

Volt-ammeters are mounted on swinging brackets, the two at the left and the upper two at the right being used for taking readings of the charging circuits. These meters are connected in circuit only when taking a reading and this is done without opening the charging circuit. The third meter at the right is for the six-rheostat charging, discharging and forming panel, to which this meter is attached. Each of these units consists of a 30-step rheostat designed to charge the 42-cell batteries at 30 to eight amperes and to discharge these batteries at 30 to 15 amperes.

The small slate section mounted above

The Only Book on the Electric Vehicle Published

"The Electric Vehicle Hand-Book"



By

H. C. CUSHING, JR.
Fellow of the American Institute Electrical Engineers

FRANK W. SMITH
President Electric Vehicle Association of America

The only complete and practical book on the Operation, Care and Maintenance of all classes of Electric Vehicles, their Storage Batteries, Motors, Controllers, Tires and Accessories.

CHAPTERS

I.—Electric Vehicle Development. By William P. Kennedy, Consulting Transportation Engineer.
II.—Lead Storage Batteries; Lead Batteries, Description; Charge and Discharge Rates; Care of Storage Batteries.
III.—Care of Lead Storage Batteries; Assembling and Putting New Batteries into Condition; Charging; Charging Overnight; Emergency Charging; Inspection; Electrolyte; Cadmium Readings; Lead Burning.
IV.—Commercial Types of Lead Storage Batteries.
V.—Alkaline Storage Batteries; Description and Care.
VI.—Charging Apparatus and Charging Stations; Alternating Current Apparatus; Isolated Plants.
VII.—Measuring Instruments, Electrical and Mechanical.
VIII.—Wheels, Rims and Tires; Their Care.
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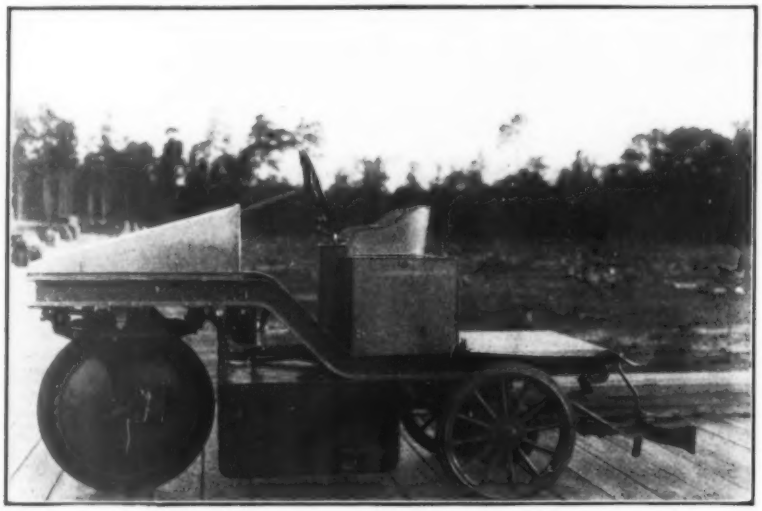
panel No. 5 shown near the center in the illustration carries a 300-ampere, zero-center-reading ammeter and an overload relay, both of which are tapped in to the neutral busbar. If the current in the neutral rises above a predetermined value the relay causes an alarm bell to ring notifying the attendant of the out-of-balance condition. He can then divide the load by means of the double-throw switches on the charging units.

This charging-equipment, being made up in sections, permits of making additions very easily, as with a sectional bookcase, and this is an important advantage since in most charging stations it is necessary to make extensions from time to time. In the Ward plant, for instance, the present equipment was hardly completed before the need for more was indicated due to growth in business. The charging equipment described is the product of the Cutler-Hammer Manufacturing Company, of Milwaukee, Wis.



Couple-Gear Freight-Wheel Company's Three-Wheeled Tractor.

New Electric Tractors.

Two new models of electrically driven equipment have been brought out recently by the Couple-Gear Freight-Wheel Company, of Grand Rapids, Mich. One is the three-wheel tram tractor, one-wheel drive, shown in one of the accompanying illustrations. This tractor is built in two sizes, one having draw-bar-pull capacity ranging up to 1,000 pounds and one having a draw-bar-pull capacity up to 1,500 pounds. These equipments have been developed particularly for lumber mill work and are being successfully used in this industry. The small tractor can handle from 2,000 to 5,000 feet per trip and the larger from 2,000 to 7,000 feet depending upon tram conditions. Speeds vary from 4 to 10 miles per hour according to loads and grades, with a maximum of 15 miles light if specified.

The front driving wheel of these tractors is equipped with three-horsepower four-pole series-wound railway motor with plastic bronze and roller bearings. The motor has a momentary overload capacity of 200 per cent and it is readily accessible without removing the wheel from the tractor.

"Couple-gear" transmission consists of an electric motor in each wheel, the motor armature having a pinion on each end, one pinion pulling up on one side of the wheel, the other pulling down at the opposite side, and both working at the periphery. The gear reduction is 25 to 1 direct.

In addition to the tram tractor described the company has recently developed a quick-detachable front-drive commercial tractor for use in connection with a number of after bodies. The latter are fitted with channels which are bent down at the forward end to receive the rear end of the tractor frame as it is backed into place. When the frame gauges the incline, causing the rear end of the frame to rise to a level position, it slides back into the steel ways, which firmly connect it with the after trailer. This raises the pilot wheel off of the ground and makes a very quickly detached outfit.

A New British Electric Vehicle Charging Station Sign.

A British Electric Vehicle Sign.

The accompanying illustration shows the E. V. C. (Electric Vehicle Committee) standard design which it is proposed to adopt in England to indicate charging stations or garages where charging facilities are provided for electric-battery vehicles. Previous references to the matter here have shown that the adoption of such a sign was under consideration as a part of the co-operative scheme of electricity-supply, battery, vehicle and other sections of the industry interested in pushing the sale and use of electrics. The design may be made either as an enameled iron sign or as an illuminated sign. In whichever type it is made, the background is to be a dark red, which is also to be the coloring of the letters on the horizontal white strip across the center of the wheel, the rest of the lettering and the wheel being white. In the case when the sign is used for a garage, the words on the white strip across the wheel will be "Charging Garage." Mr. Ayton, the honorary secretary of the Electric Vehicle Committee, who gives us this information, says that it is intended that only two colors shall be used, viz., dark red and white. In regard to dimensions of the sign, though two feet, six inches square is suggested, it is understood that this will be subject to modification to suit individual taste.

The Newtone Horn for Electrics

The Automobile Supply Manufacturing Company of Brooklyn, N. Y., is offering its improved type of "Newtone" horn for electric-vehicle use. The Newtone is operated by a small yet very powerful motor running on a ball thrust and rotating a small ratchet wheel or rotor which strikes a projection on the diaphragm and produces a loud and distinctive note.

This motor is wound regularly for use on a six-volt circuit, but is now being supplied for electric-vehicle use on a 40 and 60-volt service, and can be wound for use on any voltage specified.

Electric-vehicle manufacturers and users are gradually realizing the importance of having their cars equipped with an adequate as well as dependable signal, and for this reason are adopting motor-driven electric horns.

The Automobile Supply Manufacturing Company also manufacture an electric vibrator horn.